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Contents of No. 57.

	PAGE
Science and Art Gossip	425
Learning Languages. By R. A. Proctor	427
Our Chemistry Column. By William Jago, F.C.S.	427
Corset-Wearing. By R. A. Proctor	429
The Comet's Path in December. (*Illustrated.*)	430
The Aurora	431
The Great Sun-Spot. (*Illustrated.*)	431
The Fuel of the Sun	432
Has the Moon an Atmosphere? (*Illustrated.*) By William Noble	433
Sun-Spot Theories	434
Earthquakes in the British Isles. IV	434
French and English Railway Speed.	435
Reviews: Professor De Morgan—Electro-Motors	435
Correspondence	437
Answers to Correspondents	439
Our Mathematical Column	442
Our Whist Column	443
Our Chess Column	444

Science and Art Gossip.

The comet seems to be a fruitful subject of error—or, at least, of change of opinion. Prof. Chandler, who out-Herodes the sensation-mongers by saying the comet had actually gone through the sun, now sits in judgment on Prof. Smyth and the rest, with a new orbit, showing no coincidence with the orbits of the comets of 1843 and 1880. He seems nearer the truth this time, and we give the deduced path of the comet, with Hind's estimate for November for comparison.

Dr. Siemens' theory is getting rather roughly used. M. Faye has given one of the many proofs of its incorrectness. M. Hirn follows with three, one being that which the Editor gave in these columns immediately after the theory was published (we shall translate his paper for next week). Dr. Tommasi gives yet another disproof, ending with the remark that the hypothesis "would lead to perpetual motion, and therefore to absurdity." Those who recognised this at the outset should have spoken as plainly as we did. It would have saved much wasted time, and much misapprehension among the inexperienced.

The Electric Storm.—One of the most remarkable features attending the electrical disturbances to which we made reference last week, was that in two wires running side by side, one going about two miles further than the other, currents were travelling in opposite directions simultaneously.

America appears to have had a stronger visitation than was observed at home. The effect upon electrical apparatus in various parts of the States was very great. A supreme joke appears, however, to have been played upon the New York correspondent of one of our daily contemporaries, who wired that "Bangor worked a message a distance of 700 miles without a battery. At Milwaukee, by means of the storm alone, an electric light, requiring eight horse-power, was kept burning for some time." This is very rich. What will the gas folk say to it?

It is a noteworthy fact that every electric storm noticed recently has occurred at a time when spots of a greater or less magnitude are observed on the sun.

At a meeting of the City (London) Commissioners of Sewers, held on Tuesday week, a prolonged discussion took place on a report by Mr. W. H. Preece on the subject of electric lighting, and it was ultimately resolved by 22 to 21, "That while the Commission was in favour of electric lighting in the abstract, it was advisable to allow all further experiments to be conducted at the risk of the lighting companies, and not at the expense of the rate-payers."

Artificial turquoise are made in Paris and Vienna that cannot be distinguished by external appearances from the natural product, and when artistically made can only be distinguished by means of the file, being usually softer. The *Scientific American* says they are made from phosphate of alumina and phosphate of copper mixed together, and subjected to hydraulic pressure. Even in chemical composition it resembles the natural mineral, which is a hydrated phosphate of alumina with 2 per cent. of oxide of copper.

A correspondent sends us the following letter from Mr. Darwin, in 1873, to N. D. Doedes, a Dutch gentleman, who wrote to ask him his opinion on the existence of a God. Mr. Darwin wrote:—It is impossible to answer your question briefly; I am not sure that I could do so, even if I wrote at some length. But I may say that the impossibility of conceiving that this grand and wondrous universe, with our conscious selves, arose through chance, seems to me our chief argument for the existence of God; but whether this is an argument of real value, I have never been able to decide. I am aware that if we admit a first cause, the mind still craves to know whence it came and how it arose. Nor can I overlook the difficulty from the immense amount of suffering through the world. I am also induced to defer to a certain extent to the judgment of the many able men who have fully believed in God; but here, again, I see how poor an argument this is. The safest conclusion seems to be, that the whole subject is beyond the scope of man's intellect; but man can do his duty." This interesting letter was published first in *De Dageraad*, a Dutch Freethought paper, and has just been sent to Dr. Aveling by a Dutch Freethinker.

With the six large Edison dynamo-machines in the New York central installation, each driven by engines indicating from 120 to 150 horse-power, it has been found, says the *Engineer*, that if one machine falls in speed, the currents from the other machines short-circuit themselves through the machine which has dropped in speed, and thus overpower the engine driving it.

At a meeting of the Royal Dublin Society, Dr. G. Johnstone Stoney made a communication "On the energy expended in propelling a bicycle." Dr. Stoney referred to a bicycle match of twenty-six competitors between London and Bath, in which the winner did 214 miles in twenty-four hours, and fourteen others travelled over 150 miles a-day each. A bicyclist travelled from London to John o' Groat's House in thirteen days, being at the rate of 76 miles a-day. These were the performances of athletes, but an ordinary young person could travel 60 miles a day, and a man between 50 and 60 years of age, 30 miles a day. The result of his experiments showed

that much more energy was developed in propelling a bicycle than in any other way of applying human muscle. Taking into account the circumstances that the body of the rider was supported; that he could adjust with nicety every stroke; that the chest was in the best possible position for having full and free play; and also the extent to which fatigue was abated by exhilaration and scenery, it seemed to him (Dr. Stoney) that the ultimate comparison was not between the energy expended and the feats accomplished, but between the fatigue incurred, which was small, and the feats accomplished. Dr. Stoney, in reply to questions, said the riding of a tricycle was just above, and that of a bicycle just below, the perspiring point. It had been found that the energy expended in labour on a treadmill where the hours of labour were eight hours a day, was 3,900 foot-pound per minute, while the average energy expended on riding a bicycle was about 5,000 foot-pound per minute.

The town-clerk of Stranraer has been in correspondence with the town-clerk of Chesterfield in reference to the advantages of electric lighting, so far as experience has been obtained in that town, and the letter sent to him by Mr. Dods (town-clerk, Chesterfield) says:—"The majority of the Corporation of Chesterfield are satisfied with the lighting of the town by electricity on the ground of efficiency and economy. We have twenty-two Brush arc lights and ninety-six Lane-Fox incandescent lamps at a cost, for the present year, of £885, in place of 200 gas-lamps costing £950 per annum. The contractors are Hammond & Co." It is well to have on record such positive statements as to cost, efficiency, &c., whether they be borne out in general electric lighting practice or not. Such a statement in reference to the Chesterfield electric lighting experiment has not been previously published.

At the last meeting of the Central Board of the Miners' National Union, held at Durham, Mr. Thomas Burt, M.P., the chairman, called the attention of those present to a scheme put forward by Mr. Ellis Lever, of Manchester, to give a premium of £500 to any person who could invent the best portable electric lamp for use in mines. A letter was read from Mr. Lever, jun., stating that in his opinion a portable electric lamp to be used in mines was quite a probable thing. The meeting, looking upon the offer as important, passed the following resolution:—"That this meeting desires to tender to Mr. Ellis Lever its best thanks for his kind and generous offer to pay a premium of £500 to the person who can invent the most useful portable electric lamp to be used in mines. That should Mr. Lever still kindly consent to give the premium of £500 for this purpose, the president and secretary be empowered to correspond with him, and, if necessary, see him on the subject." It was further agreed that the president (Mr. Burt), the vice-president (Mr. Pultard), and the secretary (Mr. Crawford), should form a sub-committee to assist the praiseworthy object which Mr. Lever wishes to bring about. The question of the amount of confidence which miners may place in safety-lamps has long been debated, so that the offer will doubtless create a great interest in mining circles.

The present proprietor (except for twenty hours per week) of the Kew Botanic Gardens, is more zealous in bricking up than in unbricking. His lordly will yielded so far as to discontinue the work of closing up the Temperate House Gate: but there the woodwork is which he had set up—gladdening the souls of those who wish him to have an adequate supply of the proverbial rope.

Civilisation in the Time of Abraham.—Among the Chaldean cylinders recently discovered by Mr. Rassam in the course of his excavations in Babylonia, and upon which Mr. Theophilus G. Pinches read a most interesting paper at the last meeting of the Society of Biblical Archæology, is one of the most remarkable yet found, by reason of the light it throws upon the ancient chronology of the Chaldean Empire. It dates from the time of Nabonides, and records, among other things, that this sovereign, digging under the foundations of the Sun-God Temple at Sipara, forty-five years after the death of King Nebuchadnezzar, came upon a cylinder of Naramsin, the son of Sargon, which no one had seen for "3,200 years." This gives as the date of the ancient sovereign named 3,750 B.C. This, and the fact pointed out by Professor Oppert, who was present, that there was in those early days already "lively intercourse between Chaldea and Egypt," will have to be taken into account by future Bible critics. It is certain (says the *Jewish World*) somewhat to modify the vulgar conception—due in the first place to Dean Stanley—of Abraham, the founder of the Jews, as a wandering Arab Sheikh, a kind of nomad Bedouin as he exists in our day. The existence more than 5,500 years ago of two highly-civilised and highly-cultured Empires in Egypt and Chaldea; the fact that constant intercourse was going on between the two; again, that the high road between them led direct through Southern Palestine, and that Abraham was a native of the one great Empire and an honoured visitor in the other, cannot but serve to modify in no slight degree our notions of the wandering sheikh to whom we owe our origin. That he would have been unaffected by the culture in which he was born, and the rival civilisations between which he lived, is hardly likely. Altogether, the discovery to which Mr. Pinches has called attention may open up a new field for investigation in the matter of Akkad and Akkadian civilisation.

American common-sense, as we anticipated, is rising superior to the Langtry delusion, which crowded theatres here, to see a passable amateur in parts utterly beyond her strength, for no other reason than——than *what?* Does any one know? Or, rather, is any one ignorant?

Professor Wilson has promised a series of papers on "Our Bodies;" to begin next week with "Our Bones," and to be continued systematically on alternate weeks.

Mr. W. Mattieu Williams, leaving for awhile (in these columns) the fuel of the great centre of the universe, is going to discuss on alternate weeks the "Chemistry of Cooking," a subject about which too many are lamentably ignorant.

The author of the series "How to Get Strong" has left the chest and begun on the waist. We keep back his first paper for a week, as it would clash with this week's discussion of the corset-wearing question. He writes somewhat emphatically that his papers are *not* meant for any who would seek to obtain or restore waist strength by wearing corsets; he shows, rather, he says, how a natural corset may be formed—that is, a good waist-enclosure of muscle instead of whale-bone or steel.

Our Mathematical Column was displaced last week owing to an accession of advertisement matter. We were not at the office to decide what must give way, and this column was selected, we suppose, as considered likely to interest fewest readers. We should have made another choice: hereafter the Mathematical Column shall not be omitted two weeks running.

XUM

LEARNING LANGUAGES.

By Richard A. Proctor.

I HAVE had a rather varied experience in learning languages, for which acquisition, let me note, I have no exceptional aptitude, as some people have, so that my experience may, perhaps, be of use to many. As I have received also a great number of letters (more than eighty) relating to the Hamiltonian method, I may combine what I have to say on the general subject, with a short sketch of the advantages of that system.

All the languages of which I have any knowledge I learned for the purposes solely of reading books written in those languages. At school and college, indeed, I was taught Latin and Greek according to the system in vogue at our schools and colleges, the object of which appears to my apprehension (possibly dull) to make the use of either language, in the way of book-reading, appear to the learner the last and most remote of all the purposes for which a language can be learned. Somehow, so far from appreciating, I could never, even as a boy, read without ridicule the preposterous things which our Latin and Greek grammars set forth to teach beginners. Nor do I envy my own boys, taught from the public school grammar, such useful things as that, "B. Any finite part of the verb *sum* (*esse*), *to be*, is usually a copula or link; and a word linked by it to the subject, and completing the sense, is called a complement, both together forming the predicate, as—

	Predicate.	
Subject.	*Copula.*	*Complement.*
Præceptores	*sunt*	*inepti.*
The authors of	*are*	*quite two awfully*
this grammar	(*surely*)	*profound.*

Yet I must admire the elaborate ingenuity—if I ought not rather to say the fiendish, boy-devouring malignity—with which new difficulties are created. It is bad enough to tell your boy that "the impersonal gerundive construction implies necessity, principally in intransitive verbs, as *Corrigendum est; one would think such elaborate nonsense ought to be corrected;*" but when new and various pronunciations and modes of spelling are devised, when even our girls at Queen's College and Girton may at one time be taught to pronounce *vicissim* "vieçissim," and at another to say "We kiss 'im, *in turn*," while the familiar, but even then perplexing, *cujus* and *jusjurandum* of our boyhood assume the unfamiliar forms *cuius* and *iusiurandum*, one begins to ask, What are the commissioners in mental aberration about that they overlook their work thus? Either the schoolmaster is very much abroad, or one wishes that he were, and some sensible folk at home would undertake the work of teaching boys Latin and Greek.

It so chances that I learned to speak French as readily as English when as yet I was in about that stage of Latin in which the urchin Page is represented to have been. I learned French by being sent hap-hazard, as it were, at seven years old or so, to a French college. I remember some boys kindlier than the rest telling me as much about the French equivalents for English words as their limited knowledge of the latter language permitted. Other French was rather told me than taught me at home. I suppose I worked in some way or other, for on alternate Fridays I was marched home in triumph, decorated with a brilliantly-coloured medal (an honour to which an elder brother who went there with me failed to attain). I particularly remember the march home, because as I was grasped on either side by the bigger boys, who walked on the *trottoir*, I trotted in the central gutter, and reached home a spectacle for gods and men! But the work for which I was thus doubly decorated I do not remember. My impression is I simply picked up French as in babyhood's happy but unconscious hours I picked up my mother-tongue. I could jabber French and a good deal of Bas Bréton when the simplest book in French and many simple books in English were sealed to me. Thus when, at nine or ten years old, in England, I was rebuked by my language teacher, at an English school, for imperfect translation, I could defend myself in good French, which he, having only the French of "Stratford-atte-Bowe," could by no means understand. Like Becky Sharp, under rather similar conditions, I rather enjoyed these encounters.

But the point to be noticed is that, having thus merely picked up French by being spoken to in the language, with occasional explanation, and having subsequently studied by myself, and enjoyably, the grammar of the language, I now read French as readily, within a very little, as my own language.

Next comes Latin. Here my experience, compared with what I have since obtained in other languages, which, though not dead, have been learned as dead languages by me, assures me that the most perfect way to ensure failure in learning a language, is to begin with the careful, systematic, and purely logical study of its parts of speech. The ridiculously slow progress which all boys make with Latin in the usual hammer-and-tongs grammar-and-dictionary style of work, contrasts strangely with the ready way in which I, who had been as dull as any with Latin, picked up German without aid from any master. I am certain I have given enough time to Latin to have learned more that is useful of at least six languages than I ever *so* learned of Latin. I *have* learned the kind of Latin which I want—not critical, construction-balancing, word-weighing, sentence-analysing mastery (which is useful enough for those who want it), but the power to catch readily the meaning of an author—but I have learned this outside of school and college, and by the pleasant process of reading Latin works, instead of studying the learned twaddle of the Eton Latin grammar. And I could read Greek with enjoyment when I was utterly ignorant about the really interesting, but (for the *language*) useless knowledge in such books as Buttman's "Lexilogus" and the like.

My method of learning Latin and Greek was an imperfect anticipation of the Hamiltonian method, and must be described before the true system.

(*To be continued.*)

OUR CHEMISTRY COLUMN.

By William Jago, F.C.S.

THE interest attached to the study of almost every subject begins only after certain rudiments have been mastered. These are, however, necessary to a proper understanding and appreciation of the subject itself. Notwithstanding a desire to write chemistry as unconventionally as possible, there are yet a few preliminaries in the way of definitions to be got over. Among the first series of terms that must continually be used by the chemist there are Element, Compound, Mixture. These words have each distinct and exact meanings; the elements are those bodies which have never been separated into two or more substances by any means known. Among the

elements included in older lists were potash, soda, and lime. Sir Humphry Davy, in his electrical experiments, succeeded in splitting up soda, and obtaining from it the metal sodium; soda was necessarily then relegated from the list of elements to that of compounds. Since that time, the attack on the elements has been sustained with vigour, and during the last year or two the researches of Meyer and others have indicated a possibility of decomposing the element chlorine; should such decomposition be effected, chlorine, too, would have to be considered as a compound, rather than an element. At this point an experiment may be suggested, that, simple though it may seem, will considerably help us in defining the further terms. Procure some copper in the form of very fine turnings, or better, as filings, mix these with about three times their weight of powdered sulphur; notice that, however well mixed, the particles of copper and sulphur are still plainly visible. Put the mixture in the bottom of a 6-in. test-tube, which it should fill about two inches; heat it over a Bunsen lamp very carefully; it shortly commences to glow at the bottom; and then, without the assistance of the flame, becomes red-hot throughout the whole mass. Heat now strongly, and a considerable quantity of sulphur boils off, and condenses in the upper part of the tube. Allow it to cool, and a bluish-black substance, very unlike both the sulphur and the copper, may be taken out. This substance remaining is a *compound* of sulphur and copper. Its appearance and properties are very different from those of the constituent elements, and further, the exact quantity of each present is always definite; if, as in the experiment tried, an excess of sulphur is used, that excess simply remains unaltered, and is boiled away. This should make clear the essential difference between a mixture and a compound; the former term is applied to what is simply a mixture, without union, of substances in any proportion; a compound is produced by actual combination of elements in definite proportions. The terms, when used in chemical treatises, have always these meanings attached to them.

This law of definite proportions is one which, the more chemistry is studied, is the more seen to underlie all theories of chemistry. On weighing the copper, &c., in the experiment mentioned, it will be found that 63 of copper have united with 32 of sulphur to form 95 of sulphide of copper. When copper combines with oxygen, it does so in the proportion of 63 to 16; and if the whole series of copper compounds be observed, they will be found to contain 63, or a multiple of that weight of copper. For every other element there is also a number which represents the weight of it entering into a compound. In some cases, however, there are two compounds of the same elements; thus water consists of 2 by weight of hydrogen, and 16 of oxygen, while hydroxyl, or hydrogen peroxide, contains 2 of hydrogen and 32 of oxygen. Not only, then, does chemical combination occur in definite proportions, but when, as in this instance, two elements combine in more than one proportion, they do so in multiple proportions. These and other considerations have led chemists almost universally to adopt John Dalton's atomic theory. He, looking upon matter as consisting of extremely small and indivisible particles, called atoms, concluded that they were the units between which chemical action took place. According to this theory, when copper and sulphur unite, the union is between the atoms of each, one to one; the particle thus produced is termed a molecule; the weights 63 and 32 are also considered the respective weights of the atoms. We have in this theory one which, though not admitting of absolute proof, yet affords a simple explanation of all instances of chemical combination. There is also reason for supposing that, with the elementary bodies, the atoms unite together, and hence there are elementary as well as compound molecules.

Another point requires some little explanation, and that is the use of symbols. Chemists usually write the initial letter, or a combination of letters, instead of the full name of the element; thus, H is written for hydrogen, O for oxygen, &c. The letter not merely represents the element, but also exactly one atom of it. In writing compounds, the symbols of the two or more elements are written side by side; thus, CuS means a compound of one atom each of copper and sulphur; H_2O a compound of two atoms of hydrogen with one of oxygen. When chemical changes take place, they are generally represented by an equation—$Cu+S=CuS$. This means that one atom of copper and one of sulphur produce one molecule of the compound, copper sulphide.

Readers wishing a fuller explanation of the terms discussed in this paper, will find such given in a text-book on chemistry recently prepared by the writer, and published by Messrs. Longmans & Co.

Having now removed some slight difficulties from our way, we shall be able to proceed in the future with more descriptive papers, taking as our first subject the chemistry of sea-salt.

American Brass Cleaning.—Our American cousins have marvellous powers of *reinvention*. An example is given in your Science and Art Gossip of November 3rd, where is repeated the claims made by the United States arsenals to be the possessors [not *possessors*,—*users* only—Ed.] of the best method in all the world for cleaning brass. It is neither more nor less than the Birmingham process of "pickling," that has been practised beyond the memory of the oldest inhabitant by all the brass-founders and brass-workers there. The acid is sold retail in all the oil-shops under the workshop name of "pickleacky" ("acky" is the pet name for aquafortis or nitric acid). Not only is the "acky" borrowed from Birmingham, but also the "pail of fresh water and box of sawdust," these being always used. The article, after cleaning as described, is dipped in the "acky" and held there a second or two, then rapidly plunged into the fresh water and dried in sawdust—box-sawdust preferred. I may add that the proportions of nitric and sulphuric acid of the United States arsenal are not the best possible. I have had some experience in practical pickling, and have found that, except for cheapness, a much smaller proportion of sulphuric acid is better. In pickling electro deposits of copper, preliminary to bronzing, I prefer unmixed commercial nitric acid, *used smartly*. This is dearer than the crude impure stuff sold as "pickleacky," and, therefore, not commonly used.—W. Mattieu Williams.

Western Union Telegraph Company. — Like most other great undertakings, this company had very small beginnings, but it has steadily added line upon line to its network, has brought up competitor after competitor, and has now a business of extraordinary magnitude. In 1871-72 the company had 62,033 miles of line, 137,190 miles of wire, and 5,237 offices. The number of messages despatched during the year was 12,414,499, and the receipts were 8,457,695 dols., of which 2,790,232 dols. remained in the company's treasury as so much net income. In 1881-82, the company owned 131,060 miles of line, 374,368 miles of wire, and 12,068 offices. The number of telegrams despatched was 38,842,347; the rough receipts of the year were 17,114,165 dols., and the net receipts of the twelve months were 7,118,070 dols. The most satisfactory feature in the progress made by the company during the last ten years is the growth of the net revenue.

CORSET - WEARING.

By R. A. Proctor.

I MUST confess that I have seen with some surprise "An Observer's" advocacy of tight-lacing, and with even more surprise, knowing his great acumen and power in argument, the inadequacy (or what seems to me the inadequacy) of the arguments by which he supports his case. If we consider what the arguments employed by "An Observer" and Dr. Chadwick really establish, we shall find that they have in reality scarcely any bearing on the only points which can be regarded as actually at issue.

Dr. Chadwick maintains that in the case of women, wearing corsets, from girlhood, which produce moderate pressure and gradually modify the form, may do no harm to the health—may even in some cases give much-needed support, and will improve the figure, according to his own idea of what constitutes a good figure. "An Observer" shows that in past times the Romans (and even, perhaps, the Greeks) admired small-waisted women, that in the middle ages and in our own time they have been admired, that even men have endeavoured to become small-waisted, that many women have preserved good health with moderate or even great waist-pinching, and that even many men have not only been uninjured by tight-lacing, but have found their health improved by the practice, and have noticed a marked falling off in their health when they have for a time given it up.

All this may be admitted—may even be regarded as requiring no demonstration—and yet the reasonableness of the views of the dress-reformers may be admitted, except in so far as they may very well be attempting (as "An Observer" opines) an utterly hopeless task.

It can be proved very readily that for many centuries a crushed foot has been greatly admired among ladies in China. It can even be shown that Chinese ladies with crushed feet often retain fairly good health to a very advanced age, notwithstanding the seemingly most mischievous character of the artificial deformity. So with the long-headed deformity of which Miss Buckland told us not long ago. The folks with crushed heads, like the ladies with crushed feet, survive, as a matter of fact, what, theoretically, should bring them to an early grave.

But more. It may be admitted—and is, indeed, the case—that a small waist, like a small foot or a small hand, is pleasing to the artistic eye (so it be natural), and is moreover an evidence of what is commonly called good blood—which really means several generations free from hard bodily toil such as labourers in the field have to undergo, by which hands and feet and loins are unduly and as it were coarsely exercised, with the natural result, abnormal development.

Yet more, it may be admitted—because it chances to be true—that even as regards well-balanced strength in man, a large waist is a defect, though for some forms of exercise (and markedly for rowing) a small waist always involves weakness. I happen to have special reasons for remembering this. I had, as a young man, the waist-measurement mentioned by "An Observer," viz., 28 in., though, as I was short (5 ft. 6 in. only was, I think, my stocking-foot record as a volunteer), this did not correspond to quite the same tenuity as "An Observer" seems to consider suitable for well-made young men. My chest measurement was 42 in., my arms long (extending nearly 6 ft. horizontal), and my shoulder and upper-arm muscles exceptionally well developed. Yet though thus well supplied with most of the rowing muscles, I suffered—and very seriously at first—from the weakness of the abdominal and loin muscles. At the beginning of each term three or four weeks would pass before these muscles took kindly to their work. For the rest of the term they seemed as hard as wood; but they were in reality too small for their share of hard rowing in the old-fashioned Cambridge style. For the long races men of strong and large loins and fully-developed abdominal muscles were then, and have always been, the best fitted, though that does not prove the large-waisted men best in all-round development.

But even if we granted that small waists were good (instead of moderate waists and small hips, as in Thorwaldsen's "Jason"), and again, if we admitted that small waists were artistically pleasing (instead of being hideous in men, if the hips are wide), how would that help to show the advantage of tight-lacing? It is good to have a good biceps muscle, but sticking a good-sized padding inside your jersey, to simulate a good biceps, is of very little use. That does not illustrate tight-lacing, "An Observer" may say. No, it does not; it is not sufficiently unreasonable. Take this, then. It is good to have strong wrist muscles, which will not yield under great strain; and tying a ribbon tight round the wrist may save the ligaments of the wrist from the effects of undue efforts, besides, perhaps making the wrist look small and neat; moreover, a person who has been in the constant habit of wearing such a bandage would be apt "to suffer whenever he gave it up." Does this prove that it is well to wear tight bandages round the wrists? Nay; but it proves the reverse. It shows that their use so weakens the natural muscles by saving them their proper work, that (as Sir Edmund Beckett notes in his "Origin of the Laws of Nature") being "not exercised and less worked for the time," they decline both in size and strength.

In like manner, a waist of moderate size, enclosed by small and well-hardened muscles, is good; it shows that there is no lumber of fat either about the abdominal or lumbar muscles, or about the abdomen itself; that these muscles are fit to bear any strain likely to come upon them; that, in fine, the abdominal region is in good condition. If it is not in good condition, and a man is unwilling or unable to get it into good condition, tying it up in bandages or enclosing it within stays may be a very desirable or even a most necessary precaution. It will make the waist *look* more like the waist of a stalwart man, and may perhaps prevent pain, or fatigue, or even serious injury from the weakness of the abdominal and lumbar muscles. Doubtless when a discussion arises about the use of stays, hundreds of weaklings who have had this experience come forward, and laud their corsets; while the hundreds of thousands who have never felt the want of corsets (or have preferred steady exercise to keep their abdominal regions in good condition)* can say nothing on the subject.

But I take it that we might get quite as overwhelming a weight of evidence in the same way to show the use of wearing a truss as we have for the wearing of a corset—by men, at any rate. Two or three or more might "say they could stand and walk much longer" with a truss on

* What does "An Observer" do if he finds any muscle show signs of weakness? Does he bandage it up for ever after? I doubt the wisdom of such a course. In a railway accident in America, I had the knee-cap muscle of my left leg badly injured, and it was for a long time weak. *Therefore*, I gave it steady exercise, cold water streams, and so forth. If I had tied up my knee, I should doubtless have prevented further injury, but I should have kept the muscle worthless, and kept a worthless muscle. So if the loins and abdominal muscles are weak, you may save them from mischief by tying them up; but it is far better to make them strong—as, unless very lazy, you readily can.

XUM

"than without," and not a few would tell us "that their health relapsed whenever they gave it up." Those who had never worn a truss could give no opinion from experience; and if any philosophers had argued from theoretical considerations that most men were better without a truss, those "philosophers would get much the worst of it *in these discussions.*" The "statements of personal experience, with their variations in detail," would be all on one side, like "the ill-roasted egg" of Touchstone's illustration,—and like that egg, none the better for being one-sided. Nor will men be persuaded by such arguments to begin the wearing of corsets. "An Observer," and the letter-writer of the *English Mechanic* and "Figure Training," "may as well save their preaching"—as to men wearing corsets—"for something more amenable, or at any rate"—no, let the quotation stop there.

As to women, the case is not altogether the same—nor is it quite the same as regards the artistic question. Narrower flanks than exercise will give to well-built men, and wasp-waists for women, may be pretty to look at, and the wooden busts of Cruikshank's women * may be lovely instead of hideous, for anything I have yet shown. That part of the subject is not quite so amenable to argument, because *de gustibus non est disputandum.* But I shall try to show that, so far as the artistic question can be judged by the most celebrated examples, the argument is all against the straightly-laced, and all in favour of the curve of beauty. For this, however, illustrations are needed, and they cannot be ready for this week. Next week some Greek and Roman persons in marble shall be introduced, to show what the sculptors of old, at least, thought and taught, whom also our modern artists still follow,—and our shapeliest men and women too.

(To be continued.)

Time by Telephone.—At Ann Arbor, Mich., astronomical time is furnished by the observatory to subscribers daily at 9 o'clock a.m. by telephone. The telephone transmitter at the observatory is placed close to a Morse sounder, which is operated automatically by the observatory clock. From 8·58 to 8·59 the sounder clicks once for each second, and from 8·59 to 9 o'clock twice for each second. At 9 o'clock it ceases. The click of the sounder is heard distinctly in the receiving telephones of the subscribers.—*Operator.*

The Pennsylvania Railroad Company has purchased 2,000 tin boxes containing a few simple surgical materials likely to be wanted in cases of accident. Some of the boxes are kept on each locomotive, and they each contain one rubber compress, one package of absorbent cotton, six rolls of bandages, one pyramid of pins. With the box are the following simple directions:—When an arm or leg is crushed, causing hæmorrhage, pass compress around limb immediately below the injured part. In case of rupture of a vein, tie it lightly until arrival of the surgeon. The rupture of an artery can be distinguished by the colour of the blood, which is red, and spurts out, while a vein has dark blood, and flows continuously. For wounds on the head or face apply absorbent cotton, and bind with a bandage. The company has set a good example.

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* We have to apologise to "An Observer" for the circumstance that his paper was not fully corrected. The following changes should be made. Line 23 of article, for "one poison," read "one person." Page 416, col. 1, line 2 from bottom, for "exceptionally," read "except intentionally."—Line 13 from end of article, for "*Juvencæ,*" read "*Junceæ,*" *reed-like.*

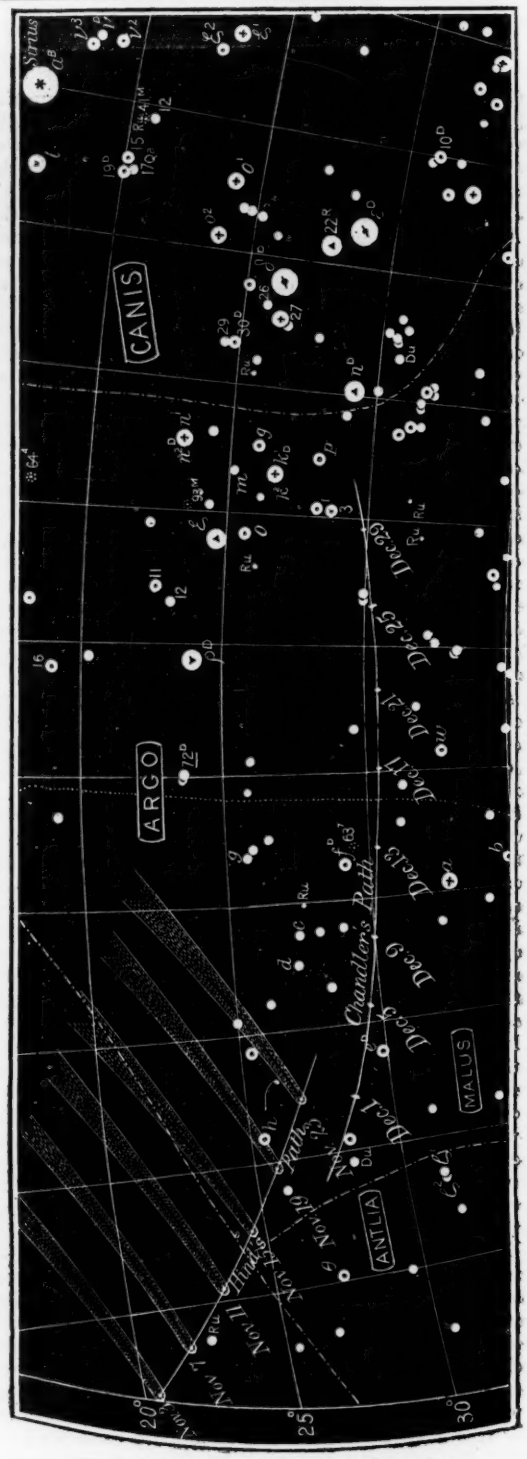

Fig. 1. Course of the Comet during December.

THE COMET'S PATH IN DECEMBER.

We give the comet's path in December as deduced from Prof. Chandler's elements of the orbit. Our figure shows the path for November, deduced from Mr.

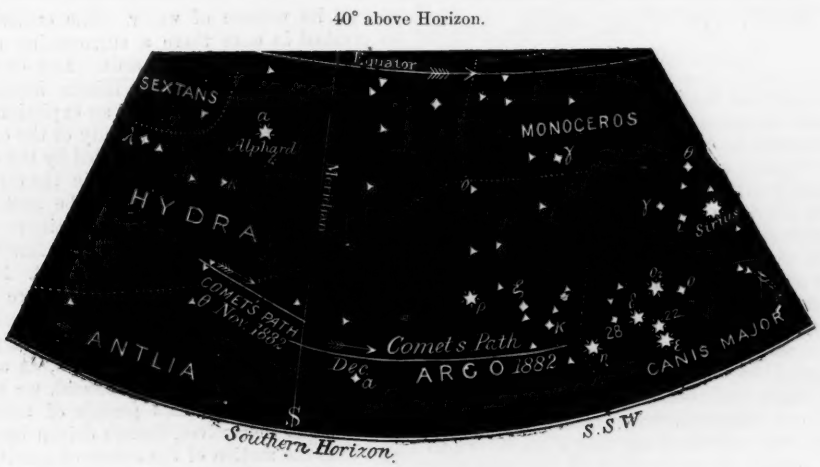

Fig. 2.

Hind's elements. It will be seen that there is considerable discrepancy. The second figure shows the position of the comet's path on

December 2, at 4·15 a.m.
December 6, at 4 a.m.
December 10, at 3·45 a.m.

For later dates we can refer our readers to "The Stars in their Seasons," now ready for issue, from which the course can be traced for any hour on any night (or in this case morning). We shall, however, give in due time a map like Fig. 2, for the morning hours in the latter half of December.

The comet still continues a conspicuous object on moonless mornings. It will probably be visible with the telescope till the end of March, 1883.

There is now no reason to believe that this comet will soon return. It is travelling along steadily enough in an orbit of great extent, though, as will be inferred from the varying estimates as time proceeds, the exact extent of the orbit is not yet known. The Vienna observation, on which our estimate of the period was (provisionally) based, turns out to have been quite incorrect.

THE AURORA.

ALMOST brilliant display of the aurora was observed on Friday evening, the 17th ult. It commenced about 4·30 with a band of beautiful yellow, almost due west, which lasted about ten minutes. A glare of rosy crimson then began to appear in the north, which soon developed into a brilliant arc, with a decidedly greater lustre and size west, where rays of the most brilliant colour were constantly shooting upwards to the zenith. At 5.30 an arc of pale lemon colour appeared under the arc of rose colour, which was greatly augmented in the east, precisely as the rose-coloured one was in the west, and like it, sending rays up to the zenith, though, of course, of a pale yellow colour. The sky due north below the second arc had a very dark appearance. This was, in fact, noticed the whole time, and seems to me to indicate that the aurora was of great extent. The two arcs at 5.45 seemed to have blended together and to be dying out; but a few minutes later the rose colour increased with great rapidity, seeming to rise in the east and pass to the west, where it was brightest. At 6.10 an arc of pale lemon colour appeared for the second time under the arc of rose colour, with the same increase of light in the east. Two minutes later occurred the most interesting sight of the whole display; a brilliant point of light appeared in the eastern horizon, a little south of the patch of light which had just appeared there; this gradually rose with almost visible motion until it had attained the length of about thirty degrees and five degrees in breadth, tapering to a blunt point at either end. Passing a degree south of Saturn, it described an arc so as to just pass over the moon and disappear in the western horizon, close to the patch of rose colour which had been almost stationary in the west during the whole display. It was visible just a minute and a half. The aurora, after this, gradually toned down into an arc of soft white light, which lasted over an hour. By 9.30 there was nothing but a faint light, like that of the rising moon. [A. G. describing the aurora as seen by himself and four others.—ED.]

THE GREAT SUN SPOT.

MR. SYDNEY HODGES has kindly forwarded to us a picture of the sun spot, as drawn by him on Nov. 19, at 8 a.m. We have inverted his picture to show the spot as it would have been seen with an erecting eyepiece, so that it may be more readily compared with our

At 8 a.m., Nov. 19. At 11 a.m., Nov. 20.

own drawing. We give both for comparison. It is singular that Mr. Hodges should have made his drawing, in our hands before last number appeared, to almost exactly the same scale as ours.

A POWDER MAGAZINE STRUCK BY LIGHTNING.—A despatch from Scutari, in Albania, dated Nov. 17, stated that the powder magazine of the fortress at that place had been exploded by lightning. There was no loss of life.

THE FUEL OF THE SUN.

(Rejoinder.)

[(1.) Not knowing what Mr. Williams meant by "mean gravitation," I paid no special attention to the word; but, of course, it was obvious he meant what he says (though he miscalculated for Venus): and that is just where he is mistaken. If the mean gravitation of Jupiter were fifty times what it is, it could not cause the body of the sun to reel or sway inside the profound fluid envelope. Only a difference of influence on one and the other could cause any difference of motion, though not a hundred times the sun's own mass, outside of him, could make his body reel in the lively way Mr. Williams imagines. He may say this is mere assertion; if so, it is assertion for assertion: but it is assertion based on some knowledge of the conditions of the problem; and whenever Mr. Williams endeavours to maintain his proposition he will find this counter assertion can be maintained effectively. But I will venture to say that when he begins to reason out the details of his assertion he will withdraw it.

(2.) The total quantity of motion or force in the universe is invariable for evermore. Certainly. But Mr. Williams wants it to be ever increasing. The sun, according to his theory, as originally propounded, was to go careering through space, getting bombarded through its own motion —or, more precisely communicating to billions of tons of matter per second the motion it possessed itself—and yet this motion was to remain unvarying. However, as subsequent reflection has given a new form to this part of the theory, we need not perhaps consider it further.

(3.) Mr. Williams will find, in Fig. 74 of my "Sun," spectroscopic evidence of motions of recession and approach quite as remarkable as that described in the Greenwich Reports. But these are movements of a cyclonic sort in the hydrogen atmosphere after disturbance by the outrush of prominence matter. Into the partial vacuum left after the passage of the ejected matter, the surrounding gas rushes with continually increasing velocity, as shown by the Greenwich observation, which indicated continual inrush towards the region of disturbance. So the rush of luminous matter athwart the sun's surface in 1859 gave no evidence of lateral ejection such as Mr. Williams' theory requires. Mere thwart motion arising at, or from below, the surface would not (he now admits, though he did not originally) do what is wanted. There must be a rush of matter from a point high above the surface in such a direction as to give the matter a free orbit round the sun—which orbit might be changed (Mr. Williams thinks, though as a matter of fact it could not be changed), by perturbations, into an orbit like that of a planet. But Mr. Williams speaks of explosions, as if the dissociated gases sent up from the sun's interior, after passing through the flaming photosphere, and being thus suddenly combined, *exploded*, hundreds of masses, like our own earth for size, "combining their propulsive efforts like the contiguous grains of powder in a gun." *Like!* Very like, if the most complete contrast means resemblance. The grains of gunpowder are suddenly converted into many times their own volume of gaseous matter; the gaseous matter in the other case, as also in the cheerful soap-bubble experiment suggested for my translation, are suddenly converted into liquid matter, occupying but a minute portion of their volume. If a globe as large as this earth, of hydrogen and oxygen duly combined, were suddenly exploded, there would be an awful disturbance, but very little expulsion of matter, for the globe would be suddenly changed into much less than the thousandth part of its volume of water. The enclosing shell would be crushed *in* were there a surrounding atmosphere, not scattered in fragments outwards. But even if there *were* an outburst such as Mr. Williams imagines, is he not aware that in the case of such an explosion high above the sun's surface, the centre of gravity of the exploding matter would remain absolutely unaffected by the explosion; and as much matter as might be sent in the direction of planetary motion, just so much would be sent in the opposite direction. This would not be very easily reconciled with the movements of the asteroidal family, if Mr. Williams' theory of the origin of this family were correct. Now if a number of loaded cannon of monstrous size were flung from the sun's surface in such sort as to be fired when several hundred thousand miles from him, expelling the ball always in the direction of planetary motion, at a velocity of not less than 250 miles or so per second, we might get something like Mr. Williams's genesis of asteroid rings; for the cannons themselves, though driven backwards in such sort that the motion of the centre of gravity of cannon and ball would not be affected at all by the explosion, would not in this way have orbits clear of the sun's globe, while the expelled ball *would* have such orbits. Thus the cannon-balls would thenceforth circulate round the sun, while the cannons would be gathered up again by him,—for future use, perhaps, in the same way. In some such way might matter be expelled from the sun, so as to form free planetary attendants going the right way round. But though this explanation is "my own ownest," I am not so enamoured of it as I suppose I ought to be.—Richard A. Proctor

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Life of a Maxim Lamp.—At the New York Post-office it has been found that the average life of a Maxim incandescent lamp (the ordinary 50 candle-power type) is nearly 1,900 hours. About 25 per cent. of the lamps in this office have burnt between 3,000 and 4,000 hours.

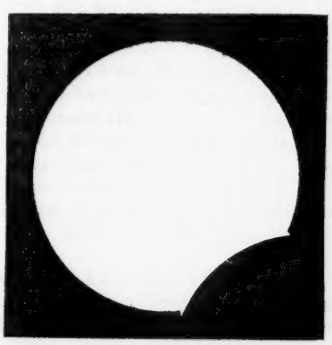
Electric Intercommunication on Trains.—A good illustration of the need of this mode of intercommunication between passengers and guards was afforded on a German railway the other day while travelling between Lottringhausen and Hörde stations, near Dortmund, in Westphalia. A fire broke out in a carriage of the train, the fire increased as the train progressed, and it was only by dint of much shouting that the unfortunate passengers at length attracted the attention of the guard, and were released from their perilous position.

Burying-place of Indians near Atures.—A strange place of interment exists at Atures, in the neighbourhood of San Fernando, New Granada, held in much veneration by the Indians. In order to reach it, a lonely savanna has to be traversed, then a river has to be crossed and an island reached bearing the name of Cucurital. Behind a thin curtain of trees and bushes is a natural grotto, formed by the overhanging of an enormous rock. Underneath this rock are hundreds of large earthen pots, each pot containing the remains of an Indian, surmounted by the skull. Some of the remains were simply wrapped in mats formed from the leaves of the Guahibos palm. There is a sacred burying-place in a cave high up the side of an almost precipitous wall of rock, to reach which requires a skilled climber endowed with a powerful grip of foot and hand, and with a head that will not be affected with vertigo. Here are found the same class of coffins, if such a term is permissible, the ghastly skulls grinning at the profaning intruder.

HAS THE MOON AN ATMOSPHERE?

I AM aware of the logical weakness of all merely negative evidence, cumulative though it may be; but I may, perhaps, be permitted to adduce my own very extensive experience in the observation of occultations of stars and planets by the moon, as tending to show that no lunar atmosphere of any appreciable density exists. If physicists are content to dignify with the name of atmosphere a condition of things cognate with that which we call a "vacuum" in a good air-pump, I have nothing more to say. If, however, by atmosphere it is intended to signify any envelope, akin in density even to the upper regions of that surrounding our own globe, then would I say that to me the moon has always seemed airless. Now I have seen stars disappear behind all parts of her limb, both illuminated and unilluminated, elevated and depressed, rugged and plain, and a more absolutely instantaneous phenomenon I am unacquainted with. I have even seen a star disappear and reappear among the mountains and valleys on the serrated edge of the moon, but without the faintest indications of distortion or diminution of light. I was, though, never so impressed with the idea of a total absence of any lunar atmosphere as I was on the occasion of the occultation of Saturn by the moon on the night of May 8, 1859, of which an account will be found in pp. 242 and 243 of Vol. XIX. of the Royal Astronomical Society's "Monthly Notices." The definition was remarkably fine, and with a power of 255 the whole of the detail of the planet was seen in a style suggestive of the engravings in works on astronomy. Now all this detail, both of immersion and emersion, was sharply visible up to the very limb of the moon. With my eye and the power I employed, I am convinced that I could not have missed any phenomenon having its origin in refraction to the extent of 1″. Nothing of the sort, though, was visible.

I must in candour, however, add that on two separate occasions when I have been observing partial solar eclipses I have noted an appearance which would seem to lend some colour to the theory that an atmosphere of considerable tenuity does surround our satellite. This appearance took the form of two exceedingly small thorns, as it were, of light, at the extremities of the solar cusps, sug gesting the idea of the sun's limb turning *very* slightly outwards at these points. The first time I saw this was on



September 28-29, 1875, when it was also witnessed by my wife and Mr. J. Lister Godlee, of the Equity Bar. Neither of them had any experience in observing, but each saw these little points at once, on viewing the eclipsed sun. The accompanying illustration of this, drawn at the telescope, is copied from the R.A.S. *Monthly Notices*, Vol. XXXVI., p. 41. I witnessed a repetition of this curious effect on May 17 last, and it may be interesting to put on record here that, having viewed it with an ordinary diagonal solar eye-piece, I removed this, and substituting a plain Huyghenean one, projected the image of the sun on to a screen, under which circumstances the "thorns" were just as visible as ever.

WILLIAM NOBLE.

HUNTING ALLIGATORS. — J. Russell, a son of Major Russell, famous during the Florida War, now makes a precarious living in South Florida as a guide to visiting sportsmen. For a bonus of two dollars he will dive into the current of the muddy St. John and bring up an alligator. He actually brings them out of their holes. Strange as this may seem, it is the only safe way to approach an alligator. They dig holes in the river-banks, just below the surface of the water and crawl into them. Jim dives down, crawls in rapidly, and seizes the saurian by the tail, who, startled, immediately backs out. Jim holds on, keeping his legs stiff till clear of the bank, when he darts away, and the alligator, rising to the surface for an instant to see what is the matter, is slain by waiting gunners in a boat. This has become common sport on the Upper St. John River.

THE DIFFUSION OF BACTERIA.—The researches of M. Pasteur and Darwin have shown how earthworms may aid the diffusion of small organisms, some of which may produce disease. Professor Schnetzler states that the dejections of earthworms always contain numerous living bacteria and their germs (the hay-bacterium included). It is clear that bacteria in enormous quantity float in the air about us; and we have at easy command, Professor Schnetzler points out, a small apparatus traversed by about 8,000 cubic centimetres of air per minute, which may inform us as to those floating germs. This is no other than the nasal cavity, on the mucous surface of which air-particles are deposited. To observe these he advises injecting the nose with distilled water (completely sterilised) by means of a glass syringe previously calcined. The liquid so obtained is put in one perfectly clean watch-glass, and covered by another. With a microscope magnifying 700 or 800 one finds, among various particles in the liquid, some real live bacteria. If the liquid be kept a few days in a clean glass tube hermetically sealed, the bacteria are found to have increased very considerably. One sees *Bacterium termo*, *vibrio*, *spirillum bacillus subtilis*, even some *infusoria*, and spores and fragments of fungi. Professor Schnetzler has further successfully cultivated the organised germs by means of a mixture of gelatine and distilled water. Why do not those bacteria in the nasal cavity always multiply and develope and penetrate to the windpipe and lungs? Their progress is, doubtless, opposed by the vibratory movements of cilia (or minute hairs) in the air-passages, and the weakly alkaline reaction of the nasal mucus may (it is also suggested) be unfavourable to some of them. Cohn has proved that bacteria producing acid fermentation perish in liquids with alkaline reaction. Infectious bacteria may, however, multiply to a formidable extent on living mucous surfaces, witness the growth of the *micrococcus* of diphtheria, brought by the air into the air-passages; also the *bacterium* of anthrax. The *bacillus* of tubercle, as Koch has lately shown, may be transmitted from one person to another by the air-passages. Professor Schnetzler thinks hay fever may also be due to bacteria entering the nose. While the development of bacteria on normal mucous surfaces is usually limited, millions of them are found in the dejections of healthy children.

XUM

SUN-SPOT THEORIES.

THE following extracts from a letter by the editor to the editor of the *Standard* will answer many queries :—

Sir,—My attention has been directed to Mr. Archibald's comments on an article in *The Standard* of November 22, respecting the great sun-spot and the aurora of the 17th inst. On referring to the article, which I had not before read, I observe that it speaks of the views of Sir E. Sabine, as "doubted by some students of these phenomena," &c. The statement is strictly correct. Students of the phenomena—that is, of sun-spots and magnetic disturbances—do not for the most part doubt that there is a connection of some sort between sun-spots, auroras, and magnetic disturbances; but some of them (M. Faye, the eminent French astronomer and mathematician, for instance) unquestionably do. The connection between sun-spots and terrestrial magnetism is not what is understood by the "sun-spottery" of which the writer of your leading article speaks with well-merited contempt. Almost every astronomer (Professor Young says every astronomer except Faye—but Faye has a following) admits the connection between sun-spots and the condition of the earth's magnetic elements; but I know of no astronomer of standing who believes in the suggested connection between sun-spots, and storms, rainfall, famines, and so forth, in detail, though many may believe that for the whole earth, or over large areas, slight changes may arise, akin to the observed fact that the temperature of the earth as a whole varies as the sun-spot period progresses.

The only question really of interest is, whether any weather predictions of the least value can be made on systems deduced from sun-spot observations. This idea was thrown out, it is well known, as a reason for a special endowment of research; but it was, and is, rejected utterly by the scientific world, even by many who are by no means opposed to the principle of endowment. When it was submitted to the Council of the Astronomical Society, in 1872, only four supported the appeal for endowment thus backed, three of these immediately retiring from the Council (stating the rejection of their views as the reason). In somewhat the same proportion that the Astronomical Society was then divided on the question the astronomical world may now be divided.

But I doubt whether even a twelfth of the astronomers of our time favour "sun-spottery"; and those astronomers who do are chiefly men whose astronomy has been but the routine work of large observatories, whose opinions about astronomy would be about as valuable as a tailor's views about anatomy. For the rest, two or three meteorologists, a few logicians (always the most illogical of men), very few physicists, and one or two who are astronomers among chemists and chemists among astronomers, are the chief advocates of the modern astrology.

Richd. A. Proctor.

London, Nov. 24.

After Dryden.

"Three Pens for three essential virtues famed,
The *Pickwick*, *Owl*, and *Waverley* were named,
The first in flexibility surpassed,
In ease the next, in elegance the last.
These points united with attractions new,
Have yielded other boons, the *Phaeton* and *Hindoo*."

Sample Box, with all the kinds, 1s. 1d. by Post.

"Let those write now who never wrote before;
And those who always wrote now write the more."—*Oban Times.*

Patentees of Pens and Penholders.

MACNIVEN & CAMERON, 33, Blair-street, Edinburgh.
Penmakers to her Majesty's Government Offices. (Est. 1770.)

EARTHQUAKES IN THE BRITISH ISLES.—IV.

THE next earthquake which seems to merit notice is the one which occurred on Oct. 23, 1839. For a fortnight before, slight earth-tremors had been experienced at Comrie, in Perthshire; but the shock, which took place on the 23rd (though it seemed to have spread from this neighbourhood as a centre), was felt over nearly the whole of Great Britain.

A gentleman who felt the shock at Monzie gives the following graphic description of what was experienced at that place :—"At thirteen minutes past ten in the evening, we heard a sound like that of a numerous body of cavalry approaching at full gallop along a grassy sward. When this had continued a few seconds, we felt two or more abrupt concussions, as if a solid mass of earth had struck against a body more ponderous than itself and rebounded. The rattling of furniture, combined with the subterranean thunder, and the reeling of what we had hitherto deemed *terra firma*, communicated at this moment a feeling of the terrific which made the stoutest heart quail. The sound passed off as before, far to the east, carrying fear into other districts." The terror was so great at Comrie that the people ran out of their houses, and assembled for prayer in the secession meeting-house, where religious exercises were continued until three in the morning. Two distinct shocks were felt while the people were thus engaged in prayer; but neither of them was so intense as the first.

We might quote many instances of the energetic action of this shock, but we shall content ourselves with two, which appear to us the most remarkable. A great dam has been formed on Cringate Muir for the supply of water to the manufactories on the Carron. The reservoir had been carefully surveyed by two of the best engineers in Scotland, yet it was burst by the shock of this earthquake, and great damage was done to property by the rush of water into the vale below. The other effect of the earthquake is perhaps yet more remarkable. We quote from the *Witness* (Edinburgh newspaper) of Jan. 22, 1840 :—"A small tract of boggy land in Morayshire, which, during the winter seasons of at least the last hundred years has been invariably more than half under water, has remained dry ever since the earthquake of last October; and several wells in the neighbourhood of Inverness, which derive their springs from fissures in the old red sandstone of the district, are only now slowly beginning to yield part of their wonted supply."

The earthquake which took place in the autumn of 1863 will be in the remembrance of most of our readers. It is chiefly interesting inasmuch as it bears so close a resemblance to the earthquake of October 30, 1868. On the whole it would appear to have been the more violent of the two. The district over which the disturbance extended in 1863 was also somewhat more extensive than that over which the effects of the later earthquake were experienced.

In 1863, the region of most violent action was in the neighbourhood of Ross (Herefordshire) and Abergavenny. There, effects were experienced which showed that a very moderate increase in the energy of the subterranean action would have rendered the earthquake a destructive one. The Golden Valley in Herefordshire, along the banks of the river Dore, was violently shaken. In fact, this earthquake seems to have affected in a particularly marked manner the beds of certain rivers in the West of England. The valleys of the Wye, and those along which flow some of the tributaries of that river, were much shaken. A

the seat of Colonel Clifford, at Llaneilio, a wall was fissured by the shock. At Ashfield, near Ross, the walls of two houses which were unfinished were partly thrown down; and at a place called Bishop's Wood, lower down on the Wye, a house near the river was rocked with so much violence that a gentleman who was asleep in a heavy old-fashioned four-post bed was nearly thrown out.

Much doubt was thrown on the statement that the earthquake was accompanied by a roaring noise, and the editor of the *Geologist* expressed his opinion that those who imagine they had heard such a noise must have deceived themselves. But the evidence we have on this point is far too clear to be discredited in this way. The Rev. H. C. Key, of Stretton Rectory, near Hereford, compared the noise which he heard to that of "a very heavy and long train rushing furiously through a station." And the gentleman who was nearly thrown out of bed, as above stated, relates that so violent a noise accompanied the shock that he imagined an explosion of gunpowder had taken place in a barge on the Wye, and he rushed to the window to see what were the effects of the supposed catastrophe. The Rev. W. S. Symonds, Rector of Pendock, who wrote an interesting paper on the subject of this earthquake for the *Popular Science Review*, says that he received the following information from a friend, who is thoroughly to be relied on:—"A man rose unusually early, and was engaged loading a cart with potatoes, which he had promised to deliver before his day's work commenced; when on a sudden, 'he heard a dreadful noise come roaring up,' apparently from a wood to the westward, and his cart rocked so violently that he was nearly thrown out of it. The trees all around him rocked violently to and fro, and the rooks rose cawing from the wood; the small birds also twittered, and took wing with notes of distress. The thunder-like noise appeared to roll off towards the east."

That the earth was shaken with considerable violence in the western parts of England during the earthquake of 1863 is shown in a remarkable manner by the effects experienced in Carmarthen Bay. Eight hours after the occurrence of the earthquake, a large column of water, shaped somewhat like a cone, and "of a dark brown colour, as if charged with earthy matter" was seen to roll forward into the bay. A small vessel with which this mass of water came in contact, "was violently pitched about, and the water thrown completely over it."

The events recorded during the last English earthquake, in 1868, had no special interest, save that which they derived from their relation to the occurrence of a phenomenon which is so unusual in our country. The shock would seem to have been one of very moderate severity, since beyond the displacement of a few light articles of furniture it produced absolutely no disturbance whatever in the buildings which were shaken by it. No walls were fissured, nothing was thrown down—in fact, nothing remained to show that the most imposing terrestrial phenomenon known to man had been experienced in our country.

The most interesting circumstance connected with that last earthquake, and that which preceded it by a few days only, in Ireland, is that they occurred during a brief cessation of the activity of Mount Vesuvius. The volcano had been in violent eruption until almost the very day of the earthquake in Ireland. It remained at rest for a few days, but the rest was only apparent; the mountain was about to be shaken by an outburst even more energetic than that which it had before given vent to. But during these few days' rest there not only occurred two earthquakes in the British Isles, but a third was experienced in Wallachia. At last the energetic action of the imprisoned fluids and elastic vapours beneath Vesuvius resulted in the formation of a new cone, through which enormous volumes of lava forced their way. We can hardly doubt that the earth-tremors experienced in the British Isles were due to the action of the subterranean matter which had been temporarily prevented from escaping through the crater of Vesuvius.

FRENCH AND ENGLISH RAILWAY SPEED.

THE French claim to be quicker in railway travelling than we are. A comparison is made by a writer in *Annales Industrielles*, who takes for the case of England data recently furnished by M. Gerhardt for twelve of the principal English lines. M. Gerhardt distinguishes commercial speed and mean speed. The former is that appearing from a comparison of the whole distance run and the whole time, including stoppages; the latter from a comparison of the same distance with the real time of travelling, deducting losses of time through diminished speed at departure or arrival, at junctions, &c. Taking express trains, it appears that the mean speed in England, with one exception, exceeds 60 kilomètres (37⅜ miles) an hour, and reaches or exceeds, in seven cases out of twelve, 63 kilomètres (39 miles); on the Great Northern particularly it is over 74 kilomètres (46 miles). The commercial speed is under 55 kilomètres (34 miles) only in one case, exceeds 60 kilomètres (37⅜ miles) in five, and on the Great Northern it reaches 66·5 kilomètres (41½ miles). The mean speed of French express trains, on the other hand, is from 59·5 to 69·8 kilomètres (37 to 43½ miles) an hour; the commercial speed, 52·4 to 63·4 kilomètres (32½ to 39½ miles) an hour. A difference between the two countries of at least 10 per cent. is recognised. Attention is called to the fact that in France junctions must not be passed at a higher speed than 20 kilomètres (12⅜ miles) for passenger trains, and 10 (6⅛ miles) for goods trains; hence a loss of time in slowing before the junction (one minute), in passage (one minute), and in regaining normal speed (one minute); or three minutes lost at each junction. In England all latitude is allowed in this matter.

[Whatever value the metric system may have, and however desirable it may be to introduce it into statistical and scientific literature, we cannot admire the way in which some of our contemporaries—as the *Times* in the above instance—publish statements in which the metric measures are used, without any figures to show (as we have done above) what are the corresponding English measures.—Ed.]

Reviews.

PROFESSOR DE MORGAN.*

PROFESSOR DE MORGAN was great in mathematics, distinguished in logic: but he was greatest, and should be most distinguished, for the protest which his life bore against the Evil Doctrine of Expediency. He not only taught the true doctrine—he practised it; he bore witness to it when witnessing to it was not the way up in the world. The paths by which many as profound in science as he, as well able to stand on their merit, with as little

* *Memoir of Augustus de Morgan.* By his Wife, Sophia Elizabeth De Morgan. With Selections from his Letters. (London: Longmans & Co.)

need to be cowards, sought advancement in his time, he would not enter upon; he forsook the companionship of men personally dear to him, he gave up offices which were agreeable to him, when right and expediency pointed different ways. He may have been sometimes mistaken; some even said he was often perverse (perhaps because his conduct shamed them more than they cared to acknowledge), but what he felt to be right he did, befall what might befall. When "he saw his duty a dead sure thing, he went for it there and then." No nobler lesson can be taught than what he taught his whole life through. He never held high official position; he earned no great wealth: but he left behind him the treasure of a worthy name. Superlatives are not needed to gild his fame; he was emphatically *an honest man*. If this is a common career, the world is fortunate; but we err greatly if the lesson taught by De Morgan was not much needed in his lifetime: is it not much needed now?

As to outward forms De Morgan was not what is called (absurdly enough) a religious man. Wearied early by the precise and formal religion, on one side, which required such and such observances daily, and on the other side by the gushing religious sentimentalism which urged him to the feet of "dear Mr. Simeon," he retained a belief which he was not eager to confess, because, as he said in his will, "such confession has always been the way up in the world."

It was and is the way up in the world to seek preferment and position by flattering those who can give it, by hiding the truth from those who do not like to hear it, by adulation so cleverly veiled that it looks like the applause which springs from true esteem and sympathy. Of this De Morgan was incapable. He resigned one office, and declined a higher office in the Astronomical Society, because he recognised "wrong-doing in the body politic;" he would not allow himself to be put in nomination for the Royal Society, because, by doing so, he would have seemed to take part in a system of which his logical mind disapproved; to the end of his life he remained plain Augustus De Morgan, "a man of few letters," B.A. of Cambridge, and a Fellow of the Astronomical Society, and worthier so than he would have been with the right (easily obtained) to add half a page of titles to his name.

Mrs. De Morgan's biography of her husband is, therefore, a book which, apart from its intrinsic interest, would be deserving of careful study. But it is full of interest. Parts of it possess the same kind of interest which was so marked a feature of his "Budget of Paradoxes"—by which, probably he is more widely known than by any other of his works. The account of his connection with the Astronomical Society, and of the feelings with which he regarded the earliest manifestation in that body of the "bias towards initiation" [query "imitation"] "of political action by which Englishmen spoil so many of their extra-political associations," will be read with interest by those who have seen that foolish spirit, after dying out again, become yet once again rife, till the society has become practically valueless. His differences with University College, and final secession from a body which had, for the sake of expediency, forsaken its principles, form a history well worth studying. He maintained, and, as the event proved, rightly, even as regards expediency, but with unquestioned truth on the ground of justice, that a university should depend on its professors, not the professors on their university. When he found that foolish men bore sway, he justly thought "the post of honour was a private station."

We learn from this book De Morgan's views on school and college training. Here, as in other things, he held that "the way up in the world" was not the best way. Success in examination secured by cram, he regarded as a discredit rather than a triumph. The wideness of his own reading had "spoiled his degree;" but he had read for love of knowledge, not for a degree; and he sought to instil this love, not mere skill in writing out answers, into his pupils.

We do not share his esteem for formal logic. From his own words, we might judge how idle is the study of logic to make men reason rightly; for he says that if the following were presented to a writer on logic without warning, he would not see the fallacy in it; whereas we hold that no man of sound reasoning powers, unspoiled by logic, can fail at once to see the fallacy:—

"To say nothing of those who succeeded by effort, there were some who owed all to fortune, for they gained the end without any attempt whatever, if, indeed, it be not more correct to say that the end gained them. But for every one who was successful with or without effort, at least one could be pointed out who began, but abandoned the trial before the result was declared. And yet, so strangely is desert rewarded in this world, there was not one of these faint-hearted men but was as fortunate as any of those who used their best endeavours."

To say that all the faint-hearted succeeded without effort, and that they were at least as numerous as all who succeeded without effort *plus* all who succeeded with effort, is obviously absurd; and if writers on logic to whom the statement was presented, with or without warning, would all fail to see the absurdity *at once*, then writing on logic must seriously impair the reasoning process.*

The book is throughout delightfully written. Many letters to some of the most eminent men of the century, and a few letters from them, add greatly to its interest. De Morgan, as all who have read his Paradoxes are aware, possessed a quaint and dry humour, and was full of antiquarian lore. It is delightful to run through his letters, catching his references to all sorts of out-of-the-way matters, and noting the strange play of a mind full of scientific and mathematical knowledge, around subjects seemingly of but little interest in themselves.

The tone with which Mrs. De Morgan writes indicates fullest sympathy with her husband's tone of mind and mode of thinking. Here and there, where mathematical expressions occur, the text requires correction. Thus, there was certainly never any contest between x and dx, though there was between $\dot{x}$ and dx. But such points are few and far between.

ELECTRO-MOTORS.†

THIS little book being the first on what we may call the latest development of electrical science, it behoves us to extend to it a more than usually charitable spirit of criticism. Nevertheless, we cannot forbear giving expression to the disappointment we experienced in perusing its pages. We had hoped to be favoured with an account of the latest experiments and discoveries concerning the conversion of electricity into motion. Much to our regret, however, we can find little but what might have been read in the magazines months since, while many of the more recent proceedings pass unmentioned. It is difficult to conceive a book on motors which makes no reference to

* Again, De Morgan says, *this* is really hard:—
For every Z there is an X, which is not Y.
Some Y's are Z's.
Inference, some X's are not Z's.
Surely it ought to be perfectly obvious. We leave it as an exercise for non-logical readers.

† *Electro-Motors:* a Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy, and its Conversion into Motive Power. By J. W. Urquhart. (Manchester: W. T. Emmott; London: Trübner & Co.)

the little "Griscom," nor could we imagine it possible for a chapter to be written on "Electric Railways" which ignores the well-known labours of Edison. These and other deficiencies, coupled with an excessive attention to introductory matter, which, from the smallness of the book, is unwarrantable, detract considerably from the value of what might, and indeed ought, to have been a most useful work. The illustrations are far too few for the subject, the first appearing on p. 29.

Anent the language, it is noticeable for what may be styled its angularity; and the author would have been amply repaid for any extra care he might have bestowed in striving to make it more palatable and smooth. A certain laxity of expression is also to be observed in places; thus, we read on p. 20, that the "current is generally *assumed to arise* at the surface of the zinc plate, which *therefore* begins to dissolve."* For those, however, who know something of the science of electricity, but little of its application, there is plenty of profitable reading to be found in the little book before us. To such we can recommend it.

A VESSEL STRUCK BY LIGHTNING.—During a severe thunderstorm which burst over Glasgow last Friday evening, the lightning struck the mizen-mast of the steamer *Prussian* at Govan, killing one man and injuring four others.

A. C., who has tried it, is authority for the following:—Take one-fourth cup of strong vinegar, crumb finely into it some bread. Let stand half-an-hour, or until it softens into a good poultice. Then apply, on retiring at night. In the morning the soreness will be gone, and the corn can be picked out. If the corn is a very obstinate one, it may require two or more applications to effect a cure.—*Scientific American.*

BURDENS UPON COMMERCE.—"It is asserted," says the *New York Herald*, "that there is no other port in the world where a ship, from the hour she enters to the hour she leaves it, is taxed so heavily as here in New York. As soon as a vessel appears off Sandy Hook the system of legalised piracy begins. Every knot she makes brings on board a different set of harpies, and they cannot be driven off until their exorbitant demands have been satisfied. When her anchor is cast, she is invaded by a fresh detachment of uniformed toll-gatherers, and still later, when she hauls up to one of the so-called wharves, another gang of officials is promptly on hand with a money demand which must be satisfied, under the pains and penalties of confiscation. The Chamber of Commerce has at last undertaken in earnest a reform of this legalised system of blackmail. The question is one of the highest importance, and we hope that this representative commercial body of the city, the State, and the country, will not allow the subject to drop until it has worked out a remedy. Our whole shipping industry is outrageously taxed and oppressed. We have in the body of our laws—federal, State, and municipal—protection for everybody and everything except the unfortunate owner of a ship and the crew who sail her. The exactions of the Barbary pirates were hardly more oppressive than those now demanded by the port officers of New York. The legal fees eat up nearly all the profits of a voyage, no matter how successful. The extortion is so great, that it is almost a wonder we have any commerce at all."

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* The italics are our own.

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

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[640]—You lately suggested that the dark side of the new moon should be watched to see whether the rim of light was brightest at the equator, the object being to detect increased atmospheric refraction where the sun's rays had been most powerful for the previous fortnight.

Last evening the new moon was above the horizon long enough after sunset for favourable observation, and I think the atmospheric conditions here enabled me to see the dark part with more distinctness than it is ever seen in England. To the naked eye the rim of light was very vivid, the irradiation effect on the illuminated side most remarkable, so that the dark moon looked like an acorn in its cup, the bright crescent being so distinctly larger; and the greatest intensity of illumination along the dark rim seemed concentrated near the southern cusp.

Getting out my telescope, a Dollond's "Student" (3 in.), new effects were observable. The dark side was so bright that, keeping the illuminated crescent out of the field, I could identify most of the larger objects on its surface. The Mare Humorum was as plainly distinguishable as in the map attached to your moon book and to Mr. Webb's book. The dark spot numbered 272 (Grimaldi) was equally plain. A distinctly luminous spot was noticeable, just corresponding, I thought, to the position of "La Hire" in the map, and I could have picked out a quantity of other detail.

But the most important fact observable seemed to me the character of the illumination of the "dark" rim. In the telescope, that which appeared to the naked eye as light shining round the orb was plainly visible as simply the bright higher surface lying along that limb of the moon seen in contrast to the great expanse of grey plains covering the dark surface (or, let me say, the half-lighted surface, for it is ridiculous to describe it as dark) from the Mare Humorum down nearly to the northern pole. And the apparent extra illumination of the rim near the southern cusp was intelligible at a glance in the telescope. A great quantity of high land brightness laps over the moon at that part, the grey plain lying further back. In the telescope no greater brightness was observable near the rim, at 276 for example, than on the surface at 188.

A bright star in Libra, Iota, or Zeta, I think (or was it Alpha?), was prettily occulted while I was watching all this a little before eight o'clock, and nothing could have been more instantaneous than its disappearance. A. P. S.

Simla, India, *Oct.* 16.

ARC ON LUNAR DISC.

[641]—Yesterday (the 17th) I happened to look at the moon about 5½ p.m., and was astonished to see a very fine arc of light completing the circle. I at once applied a power of 80 in a 3-in. telescope, but the arc of light had vanished. In its place, however, I now saw, quite distinctly, the whole of the dark portion of the disc having a dull, greenish tint. This was, of course, 6d. 6h. after new moon. Looking without the telescope, I again quite distinctly saw the fine bright arc, but again the telescope dispelled it. I now looked with a much higher power, with an ordinary field-glass, and with a good binocular, but in every one the bright arc had disappeared, though with the naked eye it still remained. I repeated the experiment several times with the same result.

Having observed a request of one of your correspondents to record any similar appearance, I send you this notice.

I was not looking for such a thing, believing that it was too long after new moon to see the earth-shine, and indeed had forgotten about the notice in KNOWLEDGE till I saw the arc. SENEX.

[Seeing the dark body of the moon so late is not unusual, under favourable atmospheric conditions. Our correspondent's observation shows that the arc of light is of exceeding faintness, as the slight absorption due to glass or binocular sufficed to render it undiscernible.—ED.]

REDUCTION OF BAROMETRICAL OBSERVATIONS.

[642]—In answer to "A Query" (631, p. 408), the following are the rules for reduction of barometric observations issued by the Meteorological Office (N.B., the instrument must be mounted in metal, not wood):—The corrections for (1) index error, (2) capacity, and (3) capillarity are combined in one general correction, obtained by observation, and given in the Kew certificate with each barometer verified there. For the correction for temperature—*i.e.*, to bring the reading to what it would be at 32° Fah.—a table is constructed, and the correction + or − can be immediately found from that for each half-inch of the mercury, and for each degree of the attached thermometer. The correction for altitude—*i.e.*, to bring the reading to "mean sea level"—is also given by a table for each inch of the mercurial column (27 to 31), and for each degree of the external air. These are always additive, as the barometer will always stand lower as we ascend above sea level.

The tables referred to may be found on pp. 80 to 89 in Mr. Scott's "Instructions in the Use of Meteorological Instruments," and in Mr. Marriott's "Hints to Meteorological Observers."

G. R. WYNNE.

MAGNETIC DISTURBANCE.

[643]—The "magnetic perturbations" in connection with the display of the Aurora Borealis of Nov. 17, 18 and 20, were generally felt throughout the North of England. The traffic over public telegraph wires was very seriously delayed, and for intensity and constancy the strongest I remember ever having witnessed. They were pretty constant (positive), and did not change their direction rapidly, thus facilitating measurements. The wires running east and west suffered the greatest.

I herewith enclose measurements, taken at intervals with "Tangent Galvanometer," extacted from diary:—

Nov. 17, 10.15 a.m. Wires running E. and W., 50°; N. and S. 30°.
Nov. 17, 10.35. a.m. Earth currents increased in intensity following measurements, E. 60°, W. full deflection. Change in direction very slow. Traffic on E. and W. wires totally stopped from 10.35 to 12.45 p.m. Wires giving full deflections at these times; 3.15 p.m., earth currents very powerful, 70°.

Nov. 18, 10.35. Strong earth currents prevailing, but change direction rapidly; E. and W. wires, 60°; N. and S. comparatively clear (10°). These strong currents prevailed until 1.15 p.m.

Nov. 20, 8.20, a.m. E. wires, 40°. W. wires, 63°. N. and S., 10°.
„ 11.30, a.m. E. „ 60°. W. „ 65°. „ „ nil.
„ 1.35, p.m. E. „ 65°. W. „ 70°. Variable.

Gawber Heights' Farm. E. PRINCE.

PAINTS FOR LANTERN-SLIDES.

[644]—Will some reader tell me what paints are best used for magic-lantern slides? C. T. B.

CORSET-WEARING.

[645]—In support of the remarks of your correspondent under the above title, may I state that in tight-lacing, as distinguished from simple corset-wearing, the shape of the waist is actually altered, and from being oval tends to become round, and that the reduction in diameter is not anterio-posteriorly, but laterally.

Now in natural breathing there is a lateral expansion of the lower part of the thoracic cavity during inspiration, as well as in other directions, and it is this lateral movement which corset-wearing tends to hinder. I fear that as yet many women will have to be persuaded of the inelegance of corset-wearing rather than of its discomfort and unhealthiness. Perhaps one day we shall believe that dress is intended to cover the body, and not that we are to adapt ourselves to the "last new style" and "latest fashion," whatever it may be.

May I ask how the "Rational Dress Association," referred to by the same correspondent, makes its doings known to the world in general? Those of us who cannot evolve a rational scheme of dress from our inner consciousness are, willy-nilly, dependent upon dressmakers; and what is their guide? A. H.

SKULL MEASUREMENTS.

[646]—As "F. R. M.'s" question in KNOWLEDGE, No. 51, asking for skull measurements, does not appear to have been answered, I venture to send you a statement:—

	C. Index.
1. Dolichocephalic, at or below ...	·73
Sub-dolichocephalic.....	·70 to ·73
2. Orthocephalic	·74 to ·79
3. Brachycephalic, at or above ...	·80
Sub-brachycephalic	·77 to ·79

These are the figures given by Professor Boyd Dawkins; they differ slightly from Dr. Thurnam's, who gives for—

1. Dolichocephalic	·70
Sub-dolichocephalic.....	·71 to ·73
2. Orthocephalic	·74 to ·76
3. Brachycephalic.....	·80 to ·89
Sub-brachycephalic	·77 to ·79

The average cephalic index for the modern English skull would be not less than 75·77, according to Dr. Thurnam. Mr. L. O. Pike has stated that the English of the present day are one of the longest-headed peoples in Europe, and, in Wiltshire, the longest without exception. Professor Welcker, cited by Dr. Thurnam, gives the breadth indices of—

Little Russians and Finns	·79
South Germans, Great Russians, and Magyars ...	·80
Swiss, Slovaks, Calmucks, and Tungusians	·81

Europe contains no typical dolichocephalic (·70 or ·71) now.

J. MAGENS MELLO, M.A., F.G.S., &c.

EFFECT OF ALCOHOL ON PIGS.

[647]—Two doctors having conducted, at the expense of a rich Swedish philanthropist, a series of experiments upon pigs, for the purpose of ascertaining the effect of alcohol on the internal organs of drunkards, fifteen pigs were treated daily upon various descriptions of alcohol, and then killed, after the process of alcoholisation had gone on for some time. Each pig had a different description of liquor. One had whisky, another had brandy, a third absinthe, and so on. When killed, their vital organs were found to be marked with small white spots, resembling ulcers. Their flesh was sound, but when sent to market it was seized as unfit for food. A dispute is now going on between the experimenters and the police as to whether the inspector of the market was not mistaken. This being the effect of their experiments on the pigs, what state must a man's body be in who drinks regularly either whisky or brandy? I should say like the pigs, or, if not worse, upon their vital organs. [?]

E. C. R.

[Alcoholisation and taking alcohol are rather different things. I have recently had rather interesting evidence of the real value of the use of so-called stimulants. When lecturing daily, and also travelling long distances, I always adopt a very light diet: tea, dry toast, and an egg for breakfast; nothing then till six, when I take tea, dry toast, and a chop; after lecturing, I take a biscuit or so with cheese, and a glass of whisky-and-water, "cold without." I tried this season the effect of omitting the whisky. Result—sleeplessness till one or two in the morning. No other harm, but weariness during following day. Taking the whisky-and-water again, after trying this a night or two, acted as the most perfect sedative.—R. A. P.]

LUMINOUS SEA.

[648]—In 1871 I was ordered to South America for the benefit of my health, and with a view to having as long a sea-trip as possible, I took passage in a sailing-vessel. While lying becalmed a couple of degrees south of the equator I had the opportunity of observing the grand phenomenon of a luminous sea, and I must say that of all the phenomena I have witnessed, none gave me greater pleasure than that alluded to. About 10 p.m. the luminosity commenced, and the whole of the sea, from the centre we occupied to the horizon all around, appeared to be one mass of phosphorescent light. Even the stars above seemed dimmed, and the sails of the ship were brightly illuminated, while every cord in the rigging was clearly distinguishable. I drew up a bucketful of the water from alongside, and found that directly the bucket touched the water the phosphorescence suddenly ceased for a few minutes in the immediate vicinity of the ship. For about ten minutes the water in the bucket was as dark as ink, but after that time again shone out, though immediately a finger was dipped in it again became dark. I have no doubt that the effect was due to certain marine animalculæ, the name of which I cannot recall to mind, and the light appeared to me

to have a bluer tinge in it than given off when a vessel drives through the water. With regard to the depth to which this phosphorescence occurred, I believe that it was confined to the surface in this case, because when I dipped a lead line some 8 or 10 in. below the surface I failed to make out the lead. At the time several dolphins were swimming about, and I noticed that at whatever point one of these fish made its appearance, the inky darkness contrasted strangely with the illuminated portion of the sea. At midnight the glare gradually decreased, and about one o'clock had entirely disappeared. A stiff breeze sprung up within a few minutes, and our good ship bowled along at the rate of nine knots the hour. When off Cape Horn I again saw a portion of the sea illuminated, but the effect was nothing like my former experience in grandeur. However, it did us one good turn by showing the approach of a large iceberg. RESSORP.

STORM IN A PICKLE-JAR.

[649]—I have lately kept in my room a homely sort of weather-glass, consisting of an oil flask turned neck downwards in a glass pickle-jar nearly full of water. It is not a very accurate instrument, but interesting observations may be made with it. For instance, the warmth of a finger and thumb on the bowl of the flask in a few seconds causes the air within to expand sufficiently to drive the intruding water further down the neck. It is also more sensitive to slight variations in the weight of the atmosphere than far more expensive instruments. During the storms of wind on Nov. 1 and 3, the barometer fell, and almost all the water was driven out of the neck of the flask, but not without a very perceptible struggle; and it was most interesting to watch the storm reproduced in almost incessant movements in the narrow neck; and before the storm outside seemed to abate at all the pickle-jar told me that the worst was over, and the water, still struggling, began to rise towards its old position. A. M. F.

DEATH-WARNING.

[650]—A friend of mine (Dr. Goodall Jones, of Liverpool) related to me the following account of a case of premonition, which I thought might prove interesting, as it is well authenticated. The names and dates Dr. Jones will give if required.

He called on a female patient on *Sunday afternoon at three o'clock;* her husband met him at the door, and said that he was about to come for him, as the patient was worse and delirious. On going upstairs the doctor found the poor woman in a very excited state, asserting that her brother (a Liverpool pilot) was drowning in the river, "which," said the husband, "is impossible, as he is out at sea, to the best of our knowledge." The doctor did what he could to soothe his patient, and left convinced that it was a case of ordinary delirium; but in the next morning's paper he read with surprise the account of the pilot's death by drowning *in the river on the previous afternoon at three o'clock.* J. SINCLAIR.

A PHENOMENON.

[651]—When in Switzerland last year, in September, in the morning, about 10 o'clock, we saw a beautiful and curious phenomenon, and I should be glad to know if it is common, and its causes. We were *en route* from Interlaken to Berne, standing on the deck of a steamer at Därligen, waiting for it to start. Above us, to the south or south-east, rose a steep, abrupt hill to a great height, and at the top it was fringed with firs, which stood out like very small Christmas trees, dark green against the sky. In one spot, however, these trees were of a bright, transparent silver, as if turned into crystal, and among and above them there glided, erratically and in all directions, apparently four or five small bright stars (about the size of third or second magnitude stars). These larger stars were plainly visible to the naked eye, but with my glasses I could make out that in this one spot the air was one glinting, glittering mass of tiny bright specks, all moving in every direction. We called the attention of the passengers to it, and many were the conjectures as to what these appearances were, and why they were. Some said birds, others falling snow, but no one gave a satisfactory explanation.

I should add that we were in the shade; that the sun was just, and only just behind and below the fringed sky-line, as we found on starting; that it was a bright day and clear; and that somehow the sun must be the cause of the phenomenon, for directly we moved off he appeared, the little stars disappeared, and the transparent fir trees returned to their natural dark green. N. R.

[Most probably the firs covered with ice-crystals, and the ice-crystals which active air-currents carried round and above the firs, were just in that position (about 22° from the sun) at which the arc of a solar halo would be formed.—ED.]

Answers to Correspondents.

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2 *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

R. B. W., SUBSCRIBER (2), S. D., THOS. THOMAS, REMEX, G. H. A., DISCIPULUS, and many others. I will at an early time give a brief account of the Hamiltonian method and of my experiences with it. GRAVITY. Your mistake lies in taking no account of the increase of your namesake as the sun is approached.—ASTRONOMICAL JUMBO. Your question could not possibly be answered in KNOWLEDGE. It is a long and arduous matter to explain the calculation for determining a comet's orbit from three observations.—PARALLAX. Find the right ascension and declination corresponding to the altitude and azimuth. You can then at once determine the longitude and latitude of a point on the earth having that star at its zenith. We cannot undertake to solve such problems as are dealt with in every book on practical astronomy.—T. H. D. Sculling is as bad as rowing for the chest, unless corrected by other exercises. The picture of an American oarsman represents a sculler.—L. ORME. Tail at least a hundred million miles long; least possible distance from earth rather a troublesome matter to calculate, and of no great interest, as the comet can nowhere approach the earth within many millions of miles.—W. B. Thanks; the illustration is absurd, of course, but near enough for *Times'* science.—M. H. C. You will find that the mistake about tangential force was corrected by myself at the earliest opportunity. See foot-note, p. 300. It was a printer's error. About Newcomb, I have forgotten what you said; but I know that what I described as erroneous he himself admitted to be so. As regards Dr. Siemens's theory, it would not much matter, I suppose, whether one particular objection failed, if another held. If one link breaks, proving another sound does little good. But I hold you mistaken as to the difference between the effects where solar atmosphere is limited and where it is assumed to be unlimited. As to cloud-bands, *what* is it you assert? Do you say that straight bands never seem arched?—H'SETT. Though I do not publish your letter, I thoroughly agree with you. The account you refer to is in a scientific sense utterly inadmissible.—H. K. L. It has never happened to me to want to know about degrees of freedom; perhaps some reader can tell where to find this mathematical expression explained.—J. SMEATON. Thousands have entertained that theory about comets' tails; but it will not stand inquiry.—J. SLUMINGTON? PENNIWAYTOR? J. SLENERIWIJTER (?). No, a cannon-ball does not rise after leaving the mouth of a horizontal cannon.—J. PARRY. It pains me to have to say that the comet as thus far observed travels not only on the Sabbath-day (which I take to be Saturday), but also on Sunday. But you must not desert it on that account; or, if you do, then to be consistent you should desert the earth also; for she does, too: aye, and moreover rotates, and reels, and nutates, and accompanies the sun on his cosmical rush through space.—S. SPENCER wants name of best manual on the Metallurgy of Gold, and methods of seeking mining, &c.—S. E. C.* We hardly differ so much as you seem to think. I quite think that, speaking logically and reasonably, the views of a man like Darwin about religion, a future life, &c., may be of great interest. (So a pound out of his pocket would be worth twenty shillings, if he chose to give it.) But you know that there are many who are prepared to *howl* if they learn that you do not hold the same views as they do on certain religious questions. Now, many prefer not to be howled at, and therefore keep their views on such matters to themselves. To ask such a one privately what his views are is all right enough, especially if he happens to be a personal friend. (Just as it is quite legitimate to ask a man for a pound for some charity.) But to regard his reply as something which may be proclaimed on the house-tops is altogether wrong. If you want to know what may be done in the way of howling, read some of the comments of certain religious papers on the letter, which should never have been published.—X. Impossible to say without seeing the specimens; and we cannot make arrangments for the forwarding of such things. Dr. Ball was mistaken about the height of the tides in those remote times.—J. BATTLE The maps for November and December will be the same in shape and character as the rest; they will also be published separately, price 2d. each.—A. H. LEE. Fear long time must elapse before the pressure of other subjects so far subsides that papers on philology can appear.—F. Y. (1). The tail of a comet is a variable appendage; most probably the tail of one week is quite different from the tail of the next week; (2) the comet of 1843 was seen from the earth

in February, that of the present year in September. As the earth is on nearly opposite sides of her orbit at those times, the comet being on both occasions near the sun or the middle of the orbit, observers naturally had to look in nearly opposite directions; (3) Many comets have been seen in about the same apparent direction as this; (4) Other comets have been seen even longer than this one.—A Hitherto Constant Reader. It is a matter of taste; among barbaric races that feeling is very strong, I believe. As men advance in civilisation it slowly dies out. I have myself an exceedingly strong distaste for it (even a contempt for it when I find any traces of it in myself), but you appear to like it. Trace out its origin, and reason a little about its significance, and I should imagine you would at least understand that those who think the dignity of manhood a matter of some import can hardly share your present views. They are natural enough, though, I must admit. When I was a lad, such views as yours were among my day-dreams. In the youth of nations it is so with them. It is idle to argue about tastes. When, however, you speak of love and reverence, I would ask what you mean. If you mean love and reverence based on actual knowledge of personal character and conduct, I say you are quite right to love and reverence what you hold to be estimable; but if, analysing your feelings, you find you have very little knowledge of character, disposition, genius, talent, temperament, and so forth, and that only the glamour of wealth or influence, or of some inbred, old-world superstition, rouses in you what you fancy is love and reverence, then I would merely remark that you are illogical. Even this I only say because you seem to invite an opinion. It is your affair, not mine. Some would be very unhappy if all their tastes and feelings were so analysed and their reasoning powers so stimulated that they had to give up what they fancy is dear to them. "Then take thine auld cloak about thee," by all means, without chilling yourself by looking for holes and worn places in it—even though they be patent to others.—J. Hartletop. By an odd coincidence, I want two more lines from the verse I have just partially quoted. I cannot in the least agree with you. I would rather err on the side of undue respect than of discourtesy towards members of the classes you refer to. Why *should* you be "abrupt and blunt" to any one, solely because "He is a wight of high renown, and thou art but of low degree." In so far as you are affected *either one way or the other* by a man's better position in the world, you fall short of what is due to your personal self-respect. Equally so in your intercourse with persons whose position is not so good as your own.—J. Gledstone. Must defer answer till I can deal at length with the matter. But that view about rays through head forming the tail has no possibility of being right.—C. J. Brown. By the same reasoning, though, you would judge a Mohammedan justified as against a Christian teacher. So far as first principles are concerned, a man of science, accustomed to weigh evidence, would be at least as likely to be right as one carefully trained all his life to cultivate faith as against evidence-weighing.—E. Tuck. Fear no space at present for that subject.—X. To take one point only, how could motion exist in the thin air which would diminish the resistance? If they were imparted, how could they be maintained? Consider the resistance against them! Get enough air to be of any use in this theory, and there must be effective resistance. However, as you say, the theory breaks down at the beginning.—J. W. Williams. To one who holds the theory of evolution through the struggle for existence has proved there can be "no doubt."—Sogn. That lasts till orbit has become circular. But after that comes distinction. No repulsive power has ever been shown to be exerted by sun on a comet, as a whole, though tail obviously repelled.—Peccavi. Nay, but post people *peccaverunt vel peccavere*, for they smashed your cast, either as inserted by you, or in stamping the lot of letters amongst which yours forwarded. But "in these nice sharp quillets of the 'drift,' good faith, I am no wiser than a daw."—C. D. Sherborn. The alternation of ideas, and even of gesture, right enough; but the kind of gesture unsuited to a time when Beatrice must have been oppressed with grief, and an honest gentleman like Benedick full of sorrow. That in response to his love Beatrice should presently urge revenge, seems natural enough, and her pain at his refusal is not petty annoyance. Beatrice felt that neither of the two old men could worthily avenge the wrong done to Hero. A sense of the cowardly security in which the two noble accusers had made their attack must have moved Beatrice strongly. As to the other point, was *Shakespeare's* Benedick *Italian?*—H. Pratt. On tossing four coins there are sixteen possible events, viz.:—In one case four heads, and in one case four tails; in four cases, threeheads and one tail; and in four cases, one head and three tails; and lastly, in six cases, two heads and two tails. The chances of these events are given by these numbers respectively. Hence the probabilities you ask for are as follows:—Of all four coins being alike, 2-16ths or 1-8th; of two being alike, 6-16ths or 3-8ths; of three being alike, 8-16ths or one-half. If you wager that an even number will be of one kind, your chance is 1-8th + 3-8ths, or one-half; so that the betting should be even.—T. A. Yes; if the condensation *could* be effected with sufficient rapidity, and in a sufficiently short time.—J. V. M., John Edwards, R. S. Standen, H. Moulton, Opifer, Geo. Harrison, S. Garratt, Thomas Lyons, A. M'D, A. H——d, G. E. Clarke, and very many others. Thanks for interesting letters; the phenomena are discussed, with due consideration of your evidence.—Louisa Byng. What *is* the soul or immortal part? Also, when did man cease to be an animal?—A. O. W. White. Know of no books graphically describing the nebular hypothesis.—P. A. Thanks for fly letter, but the kick did not necessarily indicate life. May it not have been merely the result of sudden increase of temperature? When his "crackling" curls and twists, we do not infer that piggie is alive.—Opifer. That was an evil jackdaw, but not intelligent. Cats "sleep on their heads," apparently, when electrical conditions prevail; it must be uncomfortable. The meteorological society should keep a corps of trained cats to foretell weather for them. Sun spots seem certainly associated with great and widespread magnetic disturbances of the earth, not with the other things you mention.—A. H. Empson. That contributor no longer replying.—R. Lewins, M.D. I see no impertinent curiosity in asking the question in the way you suggest, but if the question was asked with the object of publishing the answer, which the event seems to show, then there was room, I think, for objection to the proceeding. As to the views less reticently expressed in private, would he have cared to have had them published?—T. Stevens. That theory about the Star of Bethlehem seems scarcely to merit attention. The heliacal rising of Sirius is a *coarse* phenomenon, depending on refraction and other variable conditions. But, in any case, are we to associate astrological superstition with the customary views of Christians about the birth of Christ? Would not that be conceding a great deal?—H. V. The comet did not pass through the sun; but its outskirts probably grazed the sun's surface. The solidity or gaseity of the comet would not affect the thermal result of an actual collision.—J. Turner. Comet's orbit not what was thought.—T. A. R. Other subjects crowd us, so that there is scarcely room for that.—Dewi G. Such communications should not be sent to editor, but to the publishers; the editor does not keep by him spare copies to send out. If delay arises, though, the editor is blamed all the same.—Faciebat. No, certainly; you are not troublesome, but most patient. The real trouble is that kindly and considerate questioners are more than we can deal with. As to quotations, as a rule, if one is not certain it is best to go to the author—the *tempora mutantur*, &c. (as you mention), and *nemo repente* are illustrations; but I think the *ridiculus mus* usually comes out right. I happen to know most of the "Ars Poetica" by heart, so that the change of tense was wilful. The explanation of Foucault's Pendulum experiment requires rather more space than can be given here. Will give it shortly in these columns. The principle is not akin to that which explains the fall of a stone to the east of the vertical, though both depend on the earth's rotation. Sir E. Beckett's "Astronomy without Mathematics" is a delightful work. It is not a text book.—Mars. Your question a little difficult—"What foci should exist in each case between the object-glass, eye-piece, and speculum for a reflecting telescope of 200 magnifying power?" What is the object-glass of a reflecting telescope?—E. D. W. True of 1877 and of 1878 up to November. But nothing remarkable in sun and planets. Difference must have been in our own air.—Paula. (1) Mr. Proctor is not a member of that Church, (2) and therefore can give no details such as you ask for. (3) I suppose the engraver means a rising sun. (4) Comet is receding. (5) The Editor can and will persuade Mr. Proctor to name each month the planets of the month and where they are to be looked for.—C. H. Davis. Yes, that would be a solution of the fifteen puzzle, if it did not happen that, as originally propounded, that solution was excluded. It is widely known, however.—Faber. It seems useless to try to recognise any law in our English modes of spelling. Spelling "traveler" pleases Americans, and does not please us. Phonetically there should be but one "*l*." But we do not spell phonetically. (Oddly enough, Pitman, the phonetist, in his shorthand writes immediately with two *m*'s).—A. Aitken. Hard-hearted being. You tell "J." (p. 423), having let ABC be the given triangle, and found O the centre of inscribed circle, to draw OD, OE, OF perp. to AB, BC, CA, and to inscribe circles in each of the three quads thus formed. These will be the required circles touching each other and sides of ABC. "If J. wants it for 'use' you can send proof; but if he only wants to bother some of his fellow readers he might find the proof himself. It would be a pleasant employment for him for a few minutes." *Would* it? It would take him all his time, I fancy, to prove it for any case but an equilateral triangle. Try it yourself; you will find that *if* J's problem is solved, the angles DOE, EOF, and FOD are all equal, therefore their comple-

ments the angles B, C, A all equal—Q.E. *non* D.—J. A., Stockport, wishes to know how old oil paintings, having a thick, hard coating of dirty varnish, can best be restored.—S. R. C. (1) Comet's nucleus has not passed over any star. (2) "Things divine" to one man may be blasphemies to another, and *vice versâ*, what this last reverences the other may abhor. If I should tell you it "hurts my feelings" to hear men talk of a Being who must be not only Almighty, but All wise, as if he could be an unreasonable despot of the Oriental type, to be propitiated by fetishes, I hope you would "take the remark in the kindly way in which it is meant." I wonder, by the way, whether you can view Darwin's rejection of the idea of a jealous God with a tithe of the horror with which he, probably, viewed that idea, regarded as an explanation of one of the saddest of nature's laws. (3) I take it you do not play whist. Let me recommend it to you as a valuable rest after hard mental work. (4) Instructions for making a sun-dial would occupy too much space just now. Subjects crowd in so, and our price so limits our space, what can be done but to omit some?—F. C. G. Not in our line.—T. S. B. Neither is your subject.—F. W. Foster. All others greatly approve of his articles.—Harry Sweeting. Feeling yourself "able to perform that original piece of work," you offer full explanations of optical illusions, in a series of papers "probably going through a whole year of Knowledge." In the first you will explain a common looking-glass, in the next Pepper's ghost and the living head. "There are plenty of diagrams." You "hope that we will help you to become a popular science writer," and in a postscript, you "could write equally well on any other scientific subject." We will help you as far as we can, by advising you to wait until you have learned to write unequally well on different scientific subjects. — C. Gray, M. Morrison, J. Hargreave, and many others who have written about aurora—many thanks.—T. W. Bosworth, Septimus B., and others. Know nothing personally of Mr. Stanley, the African explorer.—P. Ebbutt. Pressure of correspondence prevented.—J. Greenfield. (1) Yes, Mr. Fothergill's view is as inconsistent with the narrative as the narrative with scientific possibilities. (2) If the earth reversed her rotation for 10 degrees, or even stopped rotating for a second, the heat generated would melt most of her globe. Imagine a mass at the equator travelling more than 1,000 miles an hour brought suddenly to rest! In latitude 60 north half that rate! Where we are, about twenty miles a minute! How would you like if you were in an express train, going only one mile a minute, to be brought suddenly to rest? *Did* I say that if a planet were to reverse its orbit no change would take place? I must have been dreaming. I meant to say (and think I did say) that if a planet had chanced to have had a retrograde instead of an advancing course, I believed (Laplace notwithtasnding) the solar system would have been quite as stable as it is. Those other subjects must really not be dragged in. Those who crave most to hear what science has to say about them, are just those who get angriest when science does speak her mind. Perhaps the truest thing science can say is *De minimis—de minimis minimorum—non curat scientia.*—J. C. S. Thanks. Will try to find space. Questioner asked for *any* solution.—E. M. Ryves. Thanks; a clerical error.—R. R. Baldrey. Emphatically no, I say with you; the creature you refer to is an idol, and a very hideous one.—H. C. (1.) Subject nearly done with; it was originally to have been more briefly dealt with. (2.) Darwin meant simply that science has only to give its own teachings, not to concern itself with other matters. People who want to show that Buddhism, or Mahommedanism, or any other *ism*, can or cannot be reconciled with science, are perfectly free to do so. It is no affair of science. (3.) So many things are *possible* in the sun. (4.) Cremation rather an undesirable subject. So few care about it. For my own part, I care nothing what is done with my body when I have done with it. If chessmen were made of my bones, that were about as much as I could want, and more also.—J. Fraser. Have no room for your theory of comets' tails; quite inconsistent with the evidence.—F. Barrett. Much gratified. Star maps naturally concluded with ended year. The stars come year after year the same, Knowledge must not do so. In *Cornhill Magazine* for November, there is an account of comet.—J. L. Have given as much space as can afford to rain-band spectroscope.—Expecto Crede refers J. to "A sequel to first six books of Euclid," Longmans, p. 152.—Osborne Prangley. Thanks. Subject very difficult. Touched on further in my book on "Sun." Doubt if anything known to us helps towards solution.—Sogn. *Christian Commonwealth* is not a paper we see, unless sent to us; so we have no means of knowing what they may have replied to the criticism they invited. If their response pleased you, they evidently know for whom they write. Your letter about Orkney auroras is not written quite so clearly as we could wish, or it should appear. Perhaps you form your style on the *Commonwealth*.—Sphere. Know nothing better than Todhunter.—S. Grove. A good idea.—T. Smith. They would fall in same time.—Scalpel. Bicycling is said to be good for chest. I doubt it, noting the attitude of bicyclers at top speed. Word "knickerbocker" has no meaning; simply derived from Washington Irving's story.—J. W. B. "Instantaneity" is the right way.—Puer. You surprise me. In America they clear and fill a car quickly enough.—J. Alston. Only moderate rowing; tricycle better for most. Cannot remember any microscope at stated price.—H. G. Pinfield. Usually called "power 2 linear." They talk of 6,000 magnifying power, but it has never been attained.—J. A. Ollard. Thanks. On last point, I doubt whether it is wise to study Euclid without the letters. My own experience is that the more you ease the work in such matters the better the progress in geometry.—Ignoramus. Question would open door to too much gratis advertising.—A. Crevasse. No time to solve problems. The offices which Knowledge can discharge are limited, —amongst them private tutorial work is not now included. —Cairngorm. Has that theory of comets' tails (viz., that comets are transparent bodies, and tail shows the track of solar rays through finely-divided matter) been suggested? Not by more than ten million persons, I should say; but certainly more than two millions. It is hopelessly wrong.—A Correspondent notes that the book mentioned by Mr. Fothergill, p. 407, is the "Green Hand," not the "Green Land." 'Tis true. It is also true that the "Green Hand" is one of the cleverest books (sea-books) ever written. What a disappointment Mr. G. Cupple's next sea-book, "The Two Frigates," was!—A. McLean. That would be the only way to make the Star Maps useful in Southern Hemisphere. Comet's path not looped, though much twisted. Account of comet rather too long and too full of less important details. — Upsala. (1) *Are* the diameters major and minor of the axes of cometic orbits so very distinct? If you can draw us a picture of, say, the orbit of Venus—one foot in diameter, to show without close measurement, the difference of the diameters, we will have a steel engraving made of it. (2.) Does that Gossip note read like anger? Then it very little represents our meaning. Pardon me, but the inter-planetary (not planitary) theory we were dealing with wanted hydrogen and water vapours. Yours (if you have one) possibly does not. When we sit on *that* theory it will be time to correct our mistaken notions respecting it. Oliver Goldsmith's remark that "mathematics seems a science to which the meanest intellects are equal," represents a favourite idea of those whose intellects —if this view is correct—cannot be among the meanest, because they find mathematics too many for them.—Hamlet Electrator. "As all things have emerged from darkness, what would they become if they returned thereto?" Would they not be "in the dark?" We are, as to your meaning. Give us an easier one next time.—Step. H. Saxby. Many thanks.—S. E. W. Roorda van Eysinga. We will consider about Scientific Politics. — A. F. O. The orbit would not be appreciably affected in shape near perihelion. — John Donald. It is unquestionably a physiological fact that a person weighs more after a meal than before one, strange though it may seem. Moreover, incredible though it may be deemed, "the air in the stomach which food displaces" is *not* "the heavier." — Wm. Moon, Jun. Thanks for Mr. Barber's theory of the hollowness of the planets. But what nonsense it all is!—M. Dorette Walker. The biochemic treatment of disease is not a suitable subject for these pages.—C. F. W. The sun was eclipsed (visible at Babylon) on April 19, 481 B.C., Oct. 2, 479 B.C., and on Feb. 17, 478 B.C., the second being the most important of the three.—W. B. Clarke. Such questions must be addressed to publishers. Editor cannot forward copies; has none by him to begin with, and, by the way, to finish with, too. —J. W. Stainforth. Thanks.—B. A. Brain troubles pouring in on us. That "of" for "have" is a common mistake among the uneducated; you or I could hardly fall into it, except when ill.—Ge. Eoon a misprint, I should say, for eozoon. Certainly organic, the foremost geologists say.

EGYPTOLOGY.

The figure was one of the kind called in Egyptian "Shabti" or "Ushabti," *i.e.*, "respondents." These figures were conventionally supposed to represent the deceased as one of the blessed become one with Osiris—the *justified* dead being always styled "The Osirian M or N." These porcelain-faced clay *ushabti* were buried with the dead to act as his representatives—to *respond* for him, in fact—in the under world, and to do work for him (which otherwise he would have to do for himself) in the fields of Aahlu, where certain labours of sowing, ploughing, reaping, &c., had to be gone through as part of the probationary work to be done in the under world before the final translation of the deceased to the heaven of heavens. These figures are represented with the flail, sickle, and

seed-bag. The present statuette appears to have been inscribed for one *Amenket*, "justified." Some of the hieroglyphs are unintelligible in the copy, and the inscription is evidently not complete. There is some mention of a panegyry, or religious festival, but I cannot make out the connection.

There is nothing very curious about the statuette in question. Each deceased person had several such, in various materials, buried with him in his grave; and there are many hundreds of them in every Egyptian Museum.

The dogma as to the fields of *Aahlu* was borrowed by the Greeks at a late period, and by them converted into *Elysium*. A. B. E.

BOTANY.

Alisma (621) is correct in supposing that the carbonic acid expired by plants is due to decomposition of organic matter. In all seedlings, and in the various parts of the plant, such as the flower and fruit, which are incapable of themselves of absorbing their own nourishment from the air, the presence of oxygen is necessary to convert the material in the other portions into the tissue of these growing parts. Carbonic acid is expired at all times, but is only inspired under the influence of light, but this inspiration is greatly in excess of the expiration of the same compound, and it is quite possible that the carbonic acid expired by one class of cells may simultaneously be absorbed by another and contiguous class. It appears, then, that the breathing of plants is not quite analogous to that of animals, for while in the latter the inspiration of oxygen is accompanied by destruction of matter, and subsequent removal as carbonic acid, in plants we have a conversion of matter into other forms which are for the most part retained, a small portion only being wasted as gas. Furthermore, we find a double action occurring in plants—absorption and expiration of oxygen and of carbonic acid, which result in the production of new tissue, whereas in animals we have only inspiration of oxygen and expiration of carbonic acid, and the accompanying changes are destructive. The distinction drawn between plants and animals was not intended to be absolute, as will be seen on reference to the last sentence, which commences with "the great difference;" the insertion of any sentence which could be construed to mean that there was no resemblance between plants and animals being, as it was thought, specially avoided, as I was well aware of the expiration of carbonic acid (indicative of oxidation) by the leaves, as mentioned in one of the preceding paragraphs; as also of the evolution of the same gas by the roots, whereby the preparation of plant food in the soil is forwarded, but concerning which no mention was made, as the article was already sufficiently long.

E. W. P.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XIII.

NEXT take the following illustration of a differential calculus, which is in many respects more important still than that considered in our last.

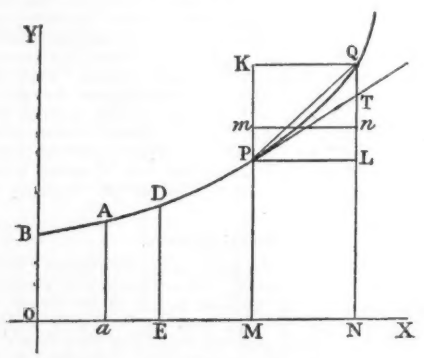


Fig. 1.

Instead of taking for the dependent variable the ordinate of a curve, take the area as a A P M (Fig. 1) measured from some fixed ordinate A a to the ordinate P M corresponding to varying value of the abscis O M or x. Putting M N = Δx, we have, if

$$u = \text{area A P M } a$$
$$u + \Delta u = \text{area A Q N } a$$
$$\Delta u = \text{area M P Q N}$$
$$\frac{\Delta u}{\Delta x} = \frac{\text{area M P Q N}}{\text{M N}} = \text{side } n\text{N of a rect. } m\text{N}$$

equal to M P Q N.

Now manifestly the smaller M N is taken the nearer is the rectangle P N in area to M P Q L: it is not merely that the difference, the area P Q L (P Q curved) is absolutely less, but it manifestly bears a constantly diminishing ratio to the area P N, until finally, when M N is taken small enough this ratio will be a vanishing one. Hence while

$$\frac{\Delta u}{\Delta x} = n\text{N}, \text{ we manifestly have } \frac{du}{dx} = \text{P M} = y,$$

or the differential coefficient of the area between a curve, the axis of x, a fixed ordinate, and the variable ordinate is this last-named ordinate. Here the language and notation of differentials are, I think, simpler and more natural than those belonging to the method of coefficients. We should say simply du the differential of the area, that is the small increment of the area, is equal to $y\,dx$, that is to the area under y and dx the differential of x, which is the same as saying that ultimately area P Q N M = rectangle P N.

But now notice the power we have obtained for determining not only areas of surfaces bounded by curved lines, but also any function which might be symbolised by such areas. When we have written of any such area as A P M a, or of any function which may be represented by such an area, the relation

$$\frac{du}{dx} = y$$

where y is some function of x, we can tell at once what u is, if only we can determine what function has y for its differential coefficient. For we have seen that no two quantities can have the same differential coefficient, unless either they are equal or differ only by a constant. (Geometrically this is much the same as saying that no other area but A P M a has P M the ordinate of curve A P Q for the measure of its rate of increase, except some area, as O B P M, E D P M, or the like, differing from a A P M by some quantity which remains constant while we vary O M, and with it P M.)

Now although determining what quantity that is which has some given function for its differential coefficient is by no means so easy or so sure a process as differentiating, yet in a great number of cases integration can be readily managed; in others it can be accomplished with more or less difficulty, and in yet others, approximations can be made to the desired integration, and the result we require can be determined with all necessary approach to exactitude.

The notation for the converse process to differentiation, or integration is as follows:—When we have a function u such that

$$\frac{du}{dx} = y,$$

we express the same relation by saying that

$$u = \int y\,dx.$$

To be more precise we may write

$$u = \int y\,dx + \text{a constant},$$

but the constant is in reality understood in the other form of expression. We may find a geometrical illustration of the equation

$$u = \int y\,dx$$

thus: Let A P Q be a curve as before, O M = x, P M = y, Mn = Δx. Then area A Q N a is the sum of a number of small rectangles like

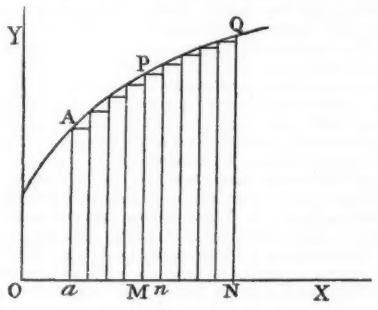


Fig. 2.

Pn, when these are made indefinitely thin. Now

$$\text{P}n = y\,\Delta x.$$

Therefore the statement, area (or u) $= \int y\,dx$, may be taken to mean that we get the area between A Q, O X, and certain boundary ordinates, by summing a multitude of very thin rectangles like Pn between the corresponding ordinates. This is an indefinite statement, and $\int y\,dx$ is called an indefinite integral. When we take definite limiting ordinates as Aa, Q N corresponding to $x = O a$, and $x = O N$ (say $x = a$ and $x = b$ respectively), we get the definite area A Q N a; and we write

$$\text{area A Q N } a = \int_a^b y\,dx$$

which means that from the value of $\int y\,dx$ when b is written for x, is to be subtracted the value when a is written for x, to give the area of the space between the ordinates corresponding to these values.

Be it noticed that what we have here said about areas applies to any quantity which might be represented by an area, and therefore practically to any quantity whatsoever. If we can obtain an expression for the small increment of any quantity u corresponding to any small increment of the variable, and can ascertain by any process what quantity that is which has such increment, we can determine u by the process of integration.

Examples will, however, best show the value of all this.

Our Whist Column.

By "Five of Clubs."

A WHIST CASE.

A and *B* are partners at Whist against *Y* and *Z*. *A* and *B* are four by honours, each having two. They claim two by honours and score them. Towards the end of the deal *A* says to *B*, "you had not two honours, had you, partner?" Before *B* replies in the affirmative the trump card is turned and quitted. *A* and *B* claim to score four by honours. *Y Z* assert that the claim is too late.—HAZARD.

[It appears to us that the claim is good, provided *A*'s question was addressed to *B* in such a way as to be unmistakably the initiation of a claim. *Z* had in that case heard enough to know that a question was raised as to the honours, and he should either have waited, or gone on dealing with the understanding that the claim was made in due time, whether he finished his deal or not before the position of the honours had been fully recalled. If *A* being in doubt says "I *think* we had four by honours," he ought not to be worse off than if he had said "We *claim* four by honours." Law 50 seems clearly to imply that the adversaries by questioning the score, interrupt the dealer (that is, that he ought to hold his hand till the question is settled) and that they may legitimately do this if they can establish their claim. Had *X* stopped when *A* spoke, and *A* failed to establish his claim, *X* would have been free to deal again, had he mis-dealt in consequence of the interruption. We may infer that *X should* have stopped.—FIVE OF CLUBS.]

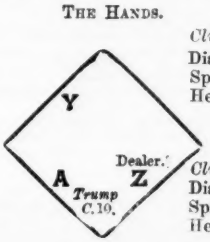
OUR esteemed correspondent, Mr. F. H. Lewis, has kindly selected and annotated three games of singular interest, one illustrating the advantage under certain conditions of keeping back the winning trump; the second, the advantage under other conditions of playing the winning trump; and the third, the necessity of keeping back the best of a plain suit at a critical stage in the game. The first of these games runs as follows:—

KEEPING BACK THE WINNING TRUMP.

THE HANDS.

Y.
Clubs—8, 4, 3.
Diamonds—8, 6.
Spades—6, 5, 4, 2.
Hearts—A, Q, 9, 5.

B.
Clubs—Kn, 5.
Diamonds—A, K, Q.
Spades—Q, Kn, 9, 8, 7.
Hearts—10, 4, 3.

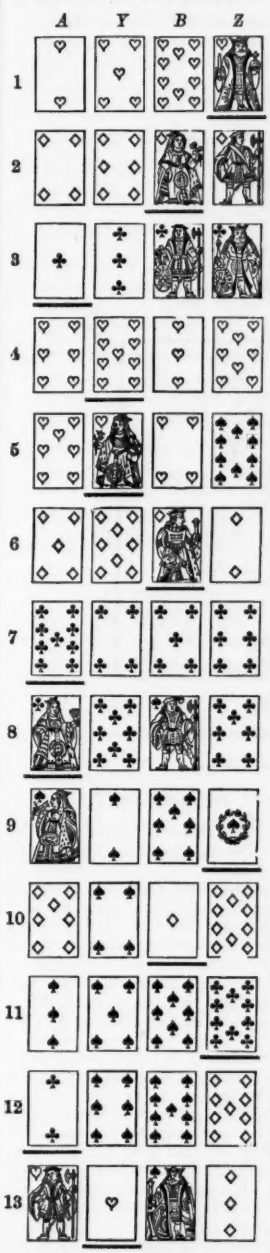


A.
Clubs—A, Q, 9, 2.
Diamonds—7, 5, 4.
Spades—Q, 3.
Hearts—Kn, 7, 6, 2.

Z.
Clubs—K, 10, 7, 6.
Diamonds—Kn, 10, 9, 3, 2.
Spades—A, 10.
Hearts—K, 8.

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



MR. LEWIS'S NOTES.

1. *A* leads from his longest suit.

3. *B*, trusting to his partner to protect the Heart suit, and being strong in both the other plain suits, leads a trump. *Z* having turned the Ten, properly heads the Knave.

4. *A* having the finesse in trumps, waits for another lead from *B*, but he should not have continued the Heart lead. *B* cannot be strong in trumps, and *A* knows that he can have no strength in Hearts. *A*'s proper lead here was the Spade Queen.

5. *Y* having no rentrée card, gives *Z* a discard. He properly abstains from continuing with Heart Ace. The discard of the Spade Ten shows *Y* that his partner had great numerical strength in Diamonds. It was open to *Z* to discard a Diamond, as the lead of trumps was from the adversary, but having four trumps originally, he had hopes of utilizing one of them.

7. *B* is in a difficulty. He knows Heart Ace to be with *Y*, but he knows also that he can have but one more Diamond, if any. As *A* continued the Heart suit, he probably wants the finesse in trumps. *B*, therefore, plays trump.

8. As *Z* discarded Spade Ten, *B* discards Spade Knave to show that his lowest Spade is equal to the Ten.

9. Acting upon this hint, *A* plays Spade Queen.

10. *Z* can count *B*'s hand. If he leads the winning trump, and draws the Club Two from *A*, he can then lead only Diamonds, and *B* will bring in his Spades.

11. *B* here properly plays Spade Eight. If *Z* passes it, *B* continues the suit, and *A* getting the discard of the Heart, *Z* loses the game. *Z* is not to be trapped. He knows he can save the game by forcing *A*, who has the losing Heart.

Q. T. V. asks why, at trick 7 (p. 410, col. 2), *B* should know that *A* had four trumps. "Correct Card," he says, indicates the higher as the proper card to play first, to show four trumps. What "Correct Card" says is, "Should partner lead trumps and you have four or more, make the signal," &c. and the signal consists in playing unnecessarily a higher card before a lower. Precisely: in *playing* such a card, not in *leading* it. As we lead the highest of a sequence and play the lowest, so to show four trumps we play a higher card before a lower, but return a lower card before a higher (this last being also the settled rule for showing that we held originally four cards of the suit). Thus, if my partner leads a small trump, and second player puts the Queen on, I holding Ten, Eight, Three, Two, play third hand the Three, and in the next round the Two, whether leading or playing to the trick; the play of the Three first round shows I hold four in the suit, so soon as the Two has appeared. But if, with the same cards, second hand plays a small card, and my Ten makes, I return the Two, and the third round then shows that I held four originally.—FIVE OF CLUBS.

X.—"*A* and *B* are partners. *B* leads when it is *A*'s turn; *Y* and *Z* call on *A* to lead from a particular suit, and *B* takes up the card

led in error, claiming that the penalty is paid; *C* and *D*, however, claim to call *B*'s card when they please." *C* and *D* can make no such claim; they have elected one penalty out of the two between which they have the right to choose. They can do no more. It is true *B* might, by showing a particular card, help his partner even more than the penalty injures him. But the chances are against it. Any way the law is clear.

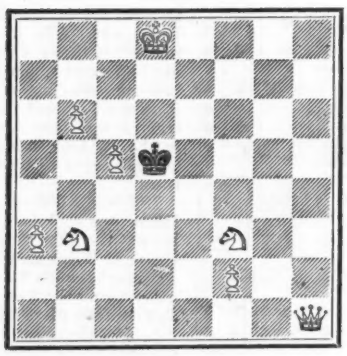
Our Chess Column.

By Mephisto.

PROBLEM No. 62.

The Quadrangle. By J. A. Miles.

Black.



White.

White to play and mate in three moves.

INTERNATIONAL CHESS TOURNAMENT.

Under the patronage of H.R.H. the Duke of Albany, an influential committee has been formed for the purpose of promoting an International chess contest in London. The Committee have issued a most promising preliminary programme and an appeal for subscriptions, from which we extract the following passages:—

"In the year of the Great Exhibition the first International Chess Tournament took place in London, and in 1862 the experiment was successfully repeated. From that period such tournaments have repeatedly taken place on the Continent, and on each occasion the interest of the chess community in all countries has been increasingly stimulated by the closeness of the contests and the development of new chess talent.

"In the numerous contests that have thus taken place on the Continent, in which more and more liberal prizes have been offered for competition, the masters of the English school—native born Englishmen, and residents on English soil—have succeeded in carrying off the chief prizes; but twenty years have passed since such a contest has taken place in England, and it is felt generally that the time has come for the chess players of this country to reciprocate the liberality that has been shown in so many foreign capitals, and that a tournament should be organised to take place in London in the spring of 1883.

"There is no member of the chess community who does not benefit by a tournament of this nature. The fine games produced are a pleasure for all time, and in adding to the stock of models of practical play, afford gratification to every amateur, however moderate may be his own skill. Every club or private individual subscribing one guinea to the funds will receive a copy of the games played.

"Subscriptions can be forwarded to the Hon. Treasurer, H. F. Gastineau, Esq.; Barnetts, Hoares & Co., Lombard-street, E.C.; or to the Hon. Secretary, J. J. Minchin, Esq., 47, Albemarle-street, W."

We recommend the project to the favourable consideration of our readers. We understand that a liberal amount has already been subscribed, but much more is yet wanted. We shall be glad to forward any subscriptions sent to us to their proper destination.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Problems received with thanks from W. Mead, Sydney Spokes, M. Beyfus, G. Woodcocks, and Leonard P. Rees; will be examined.

Gora Logue.—If the position you sent is correctly copied, then there certainly is no mate in three, but six moves are required, *i.e.*, 1. $\frac{\text{R to QKt8}}{\text{KR to B sq.!}}$ 2. $\frac{\text{R to R8 (ch),}}{}$ if 2. K takes R, then K to Kt6 (ch), or if 2. R takes R, then 3. P Queens with a (ch), &c.

Additional solutions of Problem No. 59 received from John O'Keeffe, Tefsir, W. R. Edwards, Squire, R. S. Standen, H. A. N. Reprint Problem solved by H. A. N., R. J. P., T. S. L., Henry Freeman, J. P. Problem No. 61.—John Watson, John O'Keeffe. Problem No. 60.—We have not as yet received a correct solution of this fine composition, which, owing to its difficulty, is no more than we expected. John Watson calls it a teaser, and John O'Keeffe has the merit of sending us the only attempted (although incorrect) solution.

W. Mead.—The "Sussex Chess Magazine" received; we wish you success.

J. C. H.—A player may attain a high standard (not the highest) without theoretical knowledge. Solution correct.

The *Wanganui Herald* writes as follows:—"Mr. Proctor, after finishing his great lecturing tour, founded a periodical to which he gave the ambitious title of Knowledge.* In a recent number of this publication the editor, in reply to a correspondent, said it was 'an open secret' that the author of the 'Vestiges of Creation,' was the late Robert Chambers, one of the proprietors of *Chambers' Journal*. It happens that this 'open secret' has been long exploded among literary and scientific men *au courant* of what is passing in the world of science and letters. There is no reason for silence about the work. The 'Vestiges' was the forerunner of the greater work of Charles Darwin, and if Robert Chambers had been the author, William Chambers, in his memoir of his brother, would have said so; but he gives no hint of it anywhere. Again it is not probable that a sincere and conscientious man like Robert Chambers, who was self-taught, and never darkened the doors of a University, would have sneered (as the author of the Vestiges does) at Hugh Miller, who had not, either, received a University training. So much for the negative evidence against the Chambers theory. But this evidence is not now required. The authership has been admitted, and it is known that the work was written by the late Professor Sedgwick. Professor Sedgwick's article in the *Edinburgh Review* abusing the author is now, since he is known as the writer, one of the curiosities of literature." This is news indeed. We should like to know who has been hoaxing our New Zealand friends.

* Not ambitious, surely. We named Knowledge in humble consciousness that knowledge is but the servant of wisdom.

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